MONTHLY WEATHER REVIEW,

MAY, 1880.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to June 15th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 139 Signal Service stations and 13 Canadian stations, as telegraphed to this office; 147 monthly journals and 153 monthly means from the former, and 13 monthly means from the latter; reports from 27 Sunset stations; 209 monthly registers from Voluntary Observers; 28 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The general distribution of the atmospheric pressure for the month of *May*, 1880, over the United States and Canada is shown by isobaric lines on chart No. II. At a few outlying stations the barometric means are given in figures (English inches.) The regions of highest pressure are found to cover the Middle and South Atlantic States and North Pacific coast region, the maximum means being reported from stations along the immediate coast of North Carolina. The region of lowest pressure covers the Red River of the North valley, the minimum mean for the whole country being reported by Pembina, Dak.

Departures from the Normal Values for the Month.—By comparison with the average of the means for the months of May for the past eight years, those for the present month (May, 1880) show a decided excess of pressure over the region of highest barometer along the Atlantic coast, and a large deficiency over Dakota, Minnesota and northern Wisconsin, or the region of lowest barometer. The deviations have ranged about as follows: an excess of from 0.04 inch at Jacksonville to 0.11 inch at Cape Hatteras in the South Atlantic States; from 0.07 to 0.02 from New England and the Middle States to the Ohio valley and Eastern Gulf States; and from 0.01 at Portland, Oregon and San Diego to 0.07 at San Francisco. Elsewhere a general deficiency has occurred, amounting to about 0.04 in the Southwest, along the eastern slope of the Rocky Mountains and in the Upper Lake region, and which gradually increased toward the region of lowest pressure until it reaches 0.13 at Breckenridge and 0.18 at Pembina.

Barometric Ranges.—As reduced to sea-level the total monthly range of the barometer gradually increases from south to north. It amounts to 0.40 inch at Key West and Indianola and 0.38 at Santa Fe, N. M., and Los Angeles, California; 0.55 on the North Carolina coast, 0.78 at Cairo, 0.68 at Denver and 0.47 at San Francisco; 0.66 at New York, 1.00 at Chicago and 0.86 at Roseburg, Oregon; and 0.84 at Eastport, 1.05 at Alpena, 0.92 at Breckenridge and 0.98 at Olympia.

This Paper is furnished by the Government of the United States, without charge to the Co-operating Observers acting with the Signal Office in the collection of Simultaneous Reports.

Areas of High Pressure.—Only five high areas of any importance have appeared during the month of May within the limits of the Signal Service Maps. The most important area was No. III., which first developing in the Upper Lake region on the 10th, remained over the Lakes, Tennessee, Ohio valley, Middle and South Atlantic States until the 17th.

No. I.—On the 1st a high area was central in the Southern States, the pressure being in general 0.3 above the normal. The minimum temperatures for the month for all the country east of the Mississippi river occurred this day. On the 2nd, with slowly diminishing pressure, this high area moved slowly eastward to the Carolina coast. On the 3rd and 4th it was dissipated by the advance of low area No. I, then moving in a northeasterly track along the Atlantic coast. Cautionary signals were ordered on the 1st at Indianola and Galveston, in connection with this high area and a depression near the Mexican coast; they were justified by the following maximum velocities: Indianola, E. 51; Galveston, NE. 41.

No. II.—On the 5th there was a very rapid rise of pressure on the Pacific coast in rear of low barometer No. III. The high area, slowly diminishing in pressure, remained nearly stationary in position until the 9th, when it became dissipated in advance of low area No. V. then approaching the coast from the Pacific Ocean. Considerable rain fell in Washington Territory and Oregon, and occasionalrain in northern California.

No. III.—On the 10th there was a great rise in pressure in the Northwest in rear of low area No. IV., the highest barometer being central in the Upper Mississippi valley. 11th, the high pressure moved slowly to the eastward, central over Lake Michigan. 12th, the highest barometer was transferred to the Lake Superior region. 13th, slightly increasing in pressure, the high area remained central over the Upper Lakes, the barometer being generally 0.3 above the normal. 14th, still slowly increasing in pressure the centre of high barometer was transferred to the region of Lake Huron; Alpena barometer at the afternoon report being 0.49 above the normal. On the morning of the 15th the isobar of 30.40 included nearly all the Lake region and extended into Ohio, West Virginia, and Pennsylvania. During the day there was a general diminution in pressure over this area. On the 16th it was transferred to the South Atlantic States. 17th, it was dissipated as a high pressure in advance of low area No. IV., then central in Dakota. This high area was remarkable for the persistence with which it remained in the Lake region. During its continuance the weather within the limits of the isobars of high barometer was unusually clear and pleasant. High winds are reported in connection with this area from Thatcher's Island north, to Cape Hatteras south. Cautionary Off-shore Signals were ordered on the 13th from Chincoteague to Eastport, which were justified by the following maximum velocities: Chincoteague, NW. 30; Delaware Breakwater, N. 32; Cape May, NW. 27; Sandy Hook, NW. 36; New Haven, N. 25; Thatcher's Island, NE. 47. Also Cautionary signals were ordered from Cape Henry to Wilmington. The following maximum velocities were reported: Cape Henry, N. 35; Kittyhawk, NE. 44; Cape Hatteras, NE. 32; Cape Lookout, NE. 36. The temperature within the limits of high barometer was below the mean.

No. IV.—On the 23rd there was a rapid rise of pressure on the Pacific coast in rear of depression No. VIII. Alternately slowly falling or rising the barometer remained above the normal in this region until the end of the month. During its continuance the weather within the limits of the isobars of high barometer remained fair and cool. Brisk northerly winds prevailed in California.

No. V—On the 28th a high barometer extended over the Lower Lake region and the Middle States. On the 29th the high pressure was transferred to New England, and on the 30th to the Maritime Provinces of Canada. On the 31st it disappeared beyond Nova Scotia in advance of low area No. X.

Areas of Low Pressure.—Ten areas of low barometer are charted for the month. Of these, three (Nos. III, V, VIII,) first appeared on the Pacific coast, and are charted across the Rocky Mountains, but no depression crossed the entire continent within the limits of the charts of the Signal Service. The most remarkable low-area is No. I, whose track is charted farther to the south than any depression in the month of May since the organization of this Service.

No. I.—On the 1st and 2d, the circulation of the winds in Texas showed the development of a storm-centre near the mouth of the Rio Grande. On th 3d, the low area apparently moved in an easterly track over the Gulf of Mexico; that night the centre of the depression crossed Florida, between Punta Rassa and Cedar Keys, as shown in chart No. I. On the 4th, the storm-centre moved in a northeasterly track near the South Atlantic coast. At the morning report of the 5th, the winds show that the centre of the storm was a short distance east of the North Carolina coast. Its track on that day is too indefinite to locate the centre of the depression at the hours of simultaneous observations, but, as charted, the low-area continued a northeasterly track until the morning of the 6th, when the centre can be located south of Nova Scotia and east of Maine. In its passage over Nova Scotia on the 6th, the storm developed great energy. Cautionary Signals were ordered in advance of this storm from Port Eads to Cedar Keys on the 2d; from Savannah to Cape May on the 4th and at Eastport on the 6th. The following maximum velocities are reported: Cedar Keys, SE. 25; Charleston, NE. 25; Macon, SE. 32; Cape Lookout, SE. 40; Cape Hatteras, SE. 47; Kittyhawk, NE. 38; Chincoteague, NE. 39; Eastport, N. 27. The storm track, except in Florida and in Nova Scotia, is charted at sea. The following are marine reports referring to this storm: Brig. Sisters at New York, May 9th, from Pernambuco reports heavy SE. gale on May 4th, lasting ten hours. Ship Niagara, May 5, off Hatteras, stove bulwarks, &c., during NE. gale. Bark Windermere, at New York, May

7th, from Colombo, Jan. 31st, had revolving hurricane May 5th, lasting seven hours, during which, stove bulwarks, &c. Brig. Edith Hall, at New York, May 10th, from Bahia, reports May 5th, terrific SE. gale and tremendous sea. Steamer Totaze, at New York, May 8th, from Barrow, had hurricane, May 6th, from SE. to W., lasting several hours, with terrific sea, sweeping decks. Bark Elinor, in 37° N. 70° W., May 6th, (?) had hurricane from NE. to SW., lasting twenty-four hours, during which she lost topmast, &c. The progress of this depression over the Gulf and along the States was marked by abundant rain near the line of coast.

No. II.—On the 5th, a slight depression moved in a southeasterly track over the Province of Quebec. During the night, it crossed New England, uniting on the morning of the 6th, with low-area No. I. After this junction, Nos. I and II showed a greatly increased development in energy.

No. III.—On the 4th, there was a rapid fall in pressure on the coast of Washington Territory and Oregon; the barometer at Roseburg, 0.43 below the normal; at Portland, 0.42 below the normal. On the 5th, the depression advancing rapidly to the east crossed the Rocky Mountains and was central at the 11 p. m. report in Montana and Nebraska; the barometer being below the normal at Fort Buford, 0.65; at Fort Stevenson, 0.63. On the 6th, the storm-area moved with diminishing energy in a southeasterly track into Iowa, the barometer slowly rising at the centre of the depression. At the end of this day, the lowest reading of the barometer was at Omaha, Neb., 29.45, only 0.41 below the normal. The 7th—in the morning, the centre of depression was located near Des Moines, Iowa. That day, the storm-centre pursued a northeasterly track over Wisconsin and the Lake Superior region, beyond the limits of the map. Cautionary Signals were ordered in advance of this storm on the a. m. report of the 7th for all ports in the Lake region. These signals were justified as to Lakes Michigan and Huron by the following maximum velocities: Grand Haven, SE. 30; Milwaukee, S. 35; Escanaba, S. 30; Alpena, SE. 30. On the North Pacific coast, this storm was specially severe. Twenty-five fishermen are reported drowned and some ten or fifteen of their boats lost.

No. IV.—On the 8th a depression developing east of the Rocky Mountains moved in an easterly track over Dakota; during its passage heavy rains fell in the Northwest. On the 9th the centre of the depression passed over Minnesota and Lake Superior, and the rain extended over the Upper Lake region and Ohio valley. On the 10th the low area is charted as moving in an easterly track north of the Lower Lakes. Cautionary Signals were ordered for this storm, on the morning of the 9th, for the Upper Lake region and on Lake Erie, to include Sandusky; on the morning of the 10th, to include the remaining ports in the Lower Lakes; maximum wind velocities are reported as follows: Chicago, NW. 28; Grand Haven, SE. 39; Milwaukee, SW. 36; Marquette, W. 28; Alpena, SW. 32; Sandusky, W. 40; Cleveland, W. 30; Buffalo, W. 28.

No. V.—On the 10th the barometer had a sharp fall on the North Pacific coast, accompanied by unusually heavy rains for the season, as far south as San Francisco. The rainfall extended on the following day southward to San Diego. On the 11th the barometer read at Portland 0.53 below the normal; during the day the low area moved in an easterly track over Washington Territory and Montana. On the 12th and 13th the depression progressed slowly eastward into Dakota; the barometer continued to rise at the centre of the low area, and its track is not charted after the midnight report of the 13th.

No. VI.—On the 16th a depression developed in Montana and Wyoming. On the 17th it moved slowly over Dakota; the barometer at Breckenridge at the 11 p. m. report, 29.40, being 0.4 below the normal. 18th, the low area moved over Minnesota and Lake Superior. 19th, it crossed the Province of Ontario beyond the limits of the observing stations. The rainfall accompanying this depression was in general confined to the north of the track of the storm-centre. Cautionary Signals were ordered on the 18th in advance of this storm on Lakes Michigan, Huron and Erie, to include Sandusky. These were justified at the following stations by reported maximum velocities: Grand Haven, S. 28; Port Huron, W. 31; Toledo, SW. 25.

No. VII.—At the morning report of the 20th a slight depression was developed in Texas, accompanied with general rains. During the day it moved slowly in a northeasterly track into Arkansas, with rain extending over the Gulf States. On the 21st, rapidly developing in energy, the storm-centre moved up the Ohio valley and became central near Toledo. This day heavy and general rains were reported from Tennessee, Ohio valley and Lower Lake region. On the 22nd the depression advanced in a northerly track over Lake Huron, beyond the limits of the chart. Cautionary Signals were ordered on the 21st for the Lower Lakes and Lake Huron. The following maximum velocities are reported: Buffalo, W. 25; Cleveland, SW. 32; Sandusky, S. 28; Toledo, SW. 32; Detroit, S. 25; Alpena, W. 28.

No. VIII.—At the morning report of the 22nd there was a sharp fall in pressure on the coast of Washington Territory and Oregon. During the day the centre of depression moved in an easterly track. On the 23rd, crossing the Rocky Mountains, it advanced over Montana and Dakota, and entered Manitoba. On the 24th it passed beyond the limits of the map. At the morning report of this day the barometer at Ft. Garry was 0.62 below the normal. The depression was accompanied by abundant rain.

No. IX.—On the afternoon of the 24th the barometer fell decidedly in Nebraska; the pressure at North Platte being 0.34 below the normal. Moving slowly in a northeasterly course the storm-centre at the midnight report of the 25th was near Breckenridge. On the 26th the low area advanced beyond Lake

Superior. The most abundant rain fell north of the centre of depression during the passage of the low area. South of the track precipitation did not, in general, occur until the shifting of the wind to southwest or northwest. It was during the passage of this storm-centre that the maximum temperatures for the month occurred in Missouri, Illinois, Tennessee and the Ohio valley. The warm wave gradually extended eastward and southward, giving unusually high temperatures for May over the entire country east of the Mississippi river.

No. X.—At the morning report of the 29th there was a sharp fall in pressure in Kansas and Missouri, accompanied by rain, extending to the West Gulf coast. During the day the storm, rapidly increasing in energy, moved in a northeasterly track into northern Illinois. On the 30th it moved over Lakes Michigan and Huron into the Province of Ontario. At the morning reports the barometers at Chicago, Grand Haven and Milwaukee were more than 0.5 below the normal. Its passage was marked by abundant rainfall, which extended over all the United States east of the Mississippi river. Cautionary Signals were ordered for this storm for all the Lakes, except Superior. The following maximum velocities are reported: Milwaukee, NW. 28; Grand Haven, E. 26; Alpena, E. 28; Toledo, SW. 32; Sandusky, SW. 36; Cleveland, W. 28; Erie, SE. 28; Buffalo, SW. 29; Rochester, W. 26. On the 31st the low area moved over New England into the maritime provinces of Canada with diminished energy. Signals were ordered on the 30th in advance of this storm from Cape Henry to Eastport. The following are the reported maximum velocities: Cape Henry, S. 25; Chincoteague, SE. 37; Breakwater, S. 34; Atlantic City, SE. 25; Barnegat, S. 30; Sandy Hook, SE. 26; Wood's Holl, SW. 40; Boston, S. 28.

INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present *Review*. They are for the months of *April*, 1880 and *September*, 1878. In the introduction to International Meteorology, in the *April Review*, the numbers "IV and VI" should read "IV and V", and "March, 1878," should read "March, 1880."

Chart No. IV indicates the probable course of the principal storm-areas occurring over that portion of the North Atlantic ocean, lying between the parallels of 35° and 60°N., during the month of *April*, 1880. The characteristic features of the weather, for this month, over the region under consideration, are the long continued period of good weather and—if we except the northwesterly gales from the 2nd to the 6th between the British Isles and 30°W., attending area No. I, and the gales from the 13th to the 21st, attending areas Nos. III, IV and VI,—a remarkable freedom from severe storms. Area No. I is a continuation of low area No. XV of the *March Review*. On the morning of the 1st it had passed to the east of Newfoundland, and was encountered, in about 46°N 40°W. by steamers *Braunsweig* and *Hibernian*; during the day it moved rapidly northeastward, and was followed over the Western Atlantic by an extensive area of high pressure (see high area No. I, *March Review*.) During the 2nd, 3rd, 4th and 5th, it slowly approached the British Isles as an extensive area of very low pressure; the S. S. *Sardinian*, on the morning of the 4th, in 54°N 17°W, reported barometer 29.14, or 740.1, while the British Isles were included by the isobar 29.35, or 745.4. On the morning of the 5th the pressure at Stornoway fell to 28.79, or 731.3, and during the day the wind, at this station, veered from S. to W. with slowly rising barometer. Except during the regime of the two storms, of minor importance, described as low areas Nos. I and II of *April Review*, and which passed to the north of Newfoundland on the 7th and 8th respectively, high pressures and good weather generally prevailed over the western portion of the Atlantic from the 2nd to the 10th, and over the eastern portion from the 7th to the 11th. S. S. *Adriatic*, from New York, on the 1st, to Liverpool, on the 12th, reported high pressures (except 29.97 on the 6th) and clear or fair weather throughout voyage. During the 10th, as the area of high pressures moved eastward over the British Isles, the barometer fell over the Atlantic to the westward, and on the morning of the 11th low area No. IV appeared to be central about 50°N 25°W. S. S. *Celtic*, in 50°N 23°W, reported barometer 29.70, or 754.4, wind SSW. force 4, and rain-squalls; S. S. *Strassburg*, in 49°N. 16°W, 29.89, or 759.2, SE. 2, light rain. On the west side of the centre, S. S. *Nederland*, in 46°N. 29°W., reported barometer 29.85, or 758.1, wind NNE. 3, much rain, and S. S. *Indiana*, in 48°N. 31°W., 29.97, or 761.2, N. 7, hard rain. On the morning of the 12th, the *Celtic* and *Indiana*, sailing westward, had passed into the area of high pressures, then over mid-ocean and which had moved eastward since the morning of the 8th, from the coast of the United States, while the *Strassburg*, in 49°N. 22°W. reported 29.86, or 758.4, E. 4, cloudy, and the *Nederland*, sailing eastward, in 47°N. 25°W. 29.71 or 754.6, N. 6, rain, high sea and squally. Bark *Woodlands*, in 39°N. 20°W., lost boat &c., during a SW. to W. gale, lasting 48 hours, and SW. to SE. winds, force 3 to 5, had become fully established at the Madeiras and over the Spanish Peninsula. During the 12th, 13th, 14th and 15th, this area of low pressure moved slowly east and northward from the neighborhood of the Madeiras to the coast of Ireland as a somewhat severe storm; Bark *Angelo Madre*, on the 14th, about 200 miles north of the Madeiras, experienced a heavy gale, during which she had her decks swept, and four men washed overboard and drowned On the 15th S. S. *Nederland* in 49° N., 9° W., reported barometer 29.46, or 748.3, wind NNE. 5, much rain and squally. Area No. III passed very slowly eastward, to the north of Newfoundland on the morning of the 13th, being preceded by S'ly winds, force 4 to 9, between 30° and 45° W., and followed by cold northwest gales, snow and hail. S. S. *Celtic*, in 46° N., 39° W., reported barometer 29.76 or 755.9, SSW. 6, and S. S. *Indiana*, in 42° N., 44° W., 29.74 or 755.4, SSW. 9, hard rain. On the morning of the 14th the pressure still continued quite low, but rising slowly, over Newfoundland, while the winds between 30° and 50°

W., had veered to westerly. On the morning of the 15th, the centre had moved eastward to 30° W; S. S. *Ohio* in 50° N., 25° W., reported barometer 29.88 or 758.0, S. by W. 5; S. S. *Strassburg*, 46° N. 37° W., 29.58 or 751.3, NW. 9, rain and hail showers, high seas, much water on deck; Bark *Syringa*, 46° N., 36° W., 29.80 or 756.9, WNW., fresh gale, constant showers and cross sea. On the morning of the 16th it was central about 20° W.; S. S. *Ohio*, 51° N., 17° W., reported barometer 29.25 or 743.0, SW. 5, while severe NW. to W'ly gales and very high seas prevailed from 25 to 40 W.; S. S. *Strassburg*, 45° N., 40° W., barometer 29.65 or 753.1, W. to NW., 9 to 10. Area No. V passed rapidly eastward over Newfoundland on the morning of the 16th. By the morning of the 17th, the centre had passed eastward to 30° W. and by morning of the 18th to 20° W. Bark *Syringa* reported, 17th, 46° N., 29° W., 29.20 or 741.7, W. gale, frequent heavy showers, and S. S. *Britannic*, 18th, 51° N., 23° W., 28.87 or 733.3. NW. 6, squally. Area No. VI moved eastward, to the south of Nova Scotia and Newfoundland, during the 18th and by morning of the 19th was central to the southeast of the latter; S. S. *Strassburg*, in 43° N., 51° W., reported barometer 29.67 or 753.6, S. 2. By morning of the 20th, this area had moved rapidly northeastward and was followed over the western Atlantic by the area of high pressure described in *April Review* as area No. VII; the barometer on board the Strassburg, 43° N., 55° W., had risen to 30.23 or 767.8, with clear weather. On the 21st the area of low pressure passed northeastward between the British Isles and Iceland, and high pressures covered the ocean, west of the 30th meridian. Thence to the end of April the area of high pressures moved slowly northeastwards towards northwestern Europe, until on the 30th, the pressure over the British Isles reached 30. 50 or 774.7. Areas of low barometer (No. XII and XIII of the *April Review*) moved eastward over Newfoundland on the morning of the 24th, and the afternoon of the 27th, respectively, but passed thence to the northeast without materially affecting the weather to the southward.

Chart No. V shows by isobaric and isothermal lines the mean pressure and temperature, and by small arrows the prevailing direction of the wind, at 7:35 a. m. Washington mean time, over the Northern and portions of the Southern Hemisphere for the month of *September*, 1878. The barometer observations have been corrected for temperature and reduced to sea level. At stations lying outside the area included within the lines, and for those in the Southern Hemisphere, the means are shown by figures indicating the temperature in degrees, Fahr., and the pressure in English inches. Upon comparing the distribution of atmospheric pressure for the present month (*September*, 1878,) with that for the preceding month (*August*, 1878,) the most marked changes are found to be a decided increase of pressure over the entire area included between the parallels of 30° and 60° N., and extending from 140° W. eastward over North America, the Atlantic Ocean, Europe and Asia, and a decided fall at all stations over the Atlantic Ocean to the north and south of those parallels. The increase of pressure referred to above amounts to about 0.10 inch over the small portion of the Pacific and over the eastern half of the Atlantic, from 0.10 to 0.20 over the eastern half of North America and western part of the Atlantic, about 0.15 over Europe, and from 0.20 to 0.35 over the interior of Asia. Over Hindostan, along the coast of China, and at Tokio, Japan, the increase is quite small, and at Chittagong and Nagasaki, near the southern, and at Nikolaievsk on the Amoor, near the northern margin of the zone of high pressure, a small decrease is perceptible. The most marked decrease of pressure over the Northern Hemisphere is found to the north of the British Isles, the area being bounded on the south by Sandwick, Vestervig and Stockholm, and on the east and west by Archangel and Godthaab, respectively. The decrease amounts to 0.33 inch at Stykkisholm, 0.26 at Thorshavn, 0.24 at Tromso, and 0.19 at Haparanda. The observations at all stations over the Atlantic south of 25° N., namely, Freetown, Sierra Leone, Porto Praya, Cape Verde Islands, Paramaribo, Guiana, and those in the West India Islands, show a decrease amounting to about 0.03 inch at the three former, and from 0.05 to 0.08 at the W. I. stations.

On chart No. VI are traced the paths of 24 of the principal storm-areas which traversed the northern hemisphere during the month of *September*, 1878. They fully represent the two great classes of storms experienced over the northern hemesphere, namely, those moving in an easterly path to the north of the 40th parallel, and those having the characteristics of tropical cyclones. Of the latter there are six, namely, Nos. II, X and XXI, to be found over the western portion of the Atlantic, and Nos. IV, XI and XV over the western Pacific. The tracks over the Behring Sea region are based upon reports from St. Michaels, (7 daily) St. Paul's Island, (3 daily) and Unalaska (3 daily;) and those over Hudson's Bay and Greenland upon York Factory, Schr. Florence (in Northumberland Inlet,) Godthaab and Stykkisholm.

TEMPERATURE OF THE AIR.

The mean temperature of the air for the month of *May*, 1880, is shown by isotherms on chart No. II. Compared with the average mean temperature of the past eight years for the month of May, the means for the present month show a uniform excess ranging from 3° to 7° over the entire country east of the Rocky mountains, except in Florida, the Canadian Maritime Provinces, and North and Southeast Rocky Mountain slopes, and a decided deficiency over the Western Plateau districts and North Pacific coast regions. In California the mean for San Francisco is 1°.1 above normal, while those for Sacramento and San Diego are about normal. As will be seen on examining the table of comparative temperatures given on chart No. II, the excess is greatest in the Middle Atlantic States, where it amounts to 7°.4, and the deficiency greatest in the North Pacific coast region, where it is 3°.8.

The following notes regarding the unusual high temperatures of the month are of interest: St. Louis, 8th, heat intense, one sunstroke, fatal; monthly mean temperature 4° above the average for several years.

Baltimore, 27th, two cases of sunstroke, both fatal; 29th, a marked increase of the death rate during the past week of intense heat, 190 deaths against 91 of corresponding week in May of 1879; highest monthly mean temperature on record, 6° above mean of past 10 years. Riley, Ill., monthly mean temperature 7.2° above mean of 19 years. Logan, Iowa, warmest May ever known in this section. Reading, Pa., 27th, this section of the state has suffered with the intense heat, temperature. 26th, 27th, 95° in the shade. At Birdsboro, Pa., 27th, temperature 98° in the shade; men in rolling mills compelled to stop work. At Douglasville, temperature 100° in shade. Colemansville, Lancaster county, one sunstroke, fatal. Hokendoqua, 27th, four men died from the effects of over heat. In the coal regions there has been intense suffering, most of the men compelled to stop work. New York City, 28th, 14 cases of sunstroke, 12 of which were fatal. Boston, 28th, hottest period for many years, two horses killed by heat and two persons fatally injured. Gardiner, Me., monthly mean temperature 3.4° above the mean for 44 years. Sandy Springs, Md., monthly mean temperature 7° above the normal. Thornville, Mich., warmest May for many years. Palermo, N. Y., warmest May in past 23 years. Cleveland, monthly mean temperature 8.2° above mean for past 26 years.

Maximum Temperatures.—Maine: 94° at Portland and 79° at Eastport. *New Hampshire:* 96° at *Grafton and 62° on summit of Mt. Washington. *Vermont:* 95° at *Charlotte and 86° at *Lunenburg. *Massachusetts:* 97° at Boston and 94° at Springfield. *Rhode Island:* 84° at Newport. *Connecticut:* 92° at *Southington and 89° at *Mystic and New Haven. *New York:* 95° at *Troy, *Ardenia and *Port Jervis, 94° at New York City, 79° at Buffalo and 86° at Oswego. *New Jersey:* 101° at *New Lisbon, 98° at *New Brunswick and 89° at Atlantic City. *Pennsylvania:* 98° at *Egypt, 96° at Philadelphia and *Milton and 94° at Pittsburg. *Delaware:* 94° at *Dover. *Maryland:* 95° at *Woodstock and 93° at Baltimore. *District of Columbia:* 96° at Washington. *Virginia:* 98° at Norfolk and 97° at *Accotink. *West Virginia:* 88° at *Helvetia and 86° at Morgantown. *North Carolina:* 100° at *Weldon, 92° at Wilmington and 87° at *Franklin. *South Carolina:* 89° at Charleston. *Georgia:* 90° at *Forsyth and 89° at Savannah and Augusta. *Florida:* 96° at *Houston, 95° at Jacksonville, 90° at Key West and 88° at Pensacola. *Alabama:* 92° at Montgomery and 90° at Mobile. *Mississippi:* 93° at Vicksburg and 86° at *Fayette. *Louisiana:* 96° at Pt. Pleasant and 88° at New Orleans. *Texas:* 108° at *Ringgold, 104° at Eagle Pass and 100° at Stockton and Laredo. *Ohio:* 94° at *Ruggles, 88° at Cincinnati and 86° at Cleveland. *Kentucky:* 90° at *Bowling Green and Louisville. *Tennessee:* 91° at Memphis and 86° at *McMinnville. *Arkansas:* 91° at Little Rock and 80° at *Mt. Ida. *Michigan:* 91° at *Hudson, 90° at *Thornville and 83° at Grand Haven. *Indiana:* 93° at *Vevay and 85° at Indianapolis. *Illinois:* 92° at *Peoria, 88° at Cairo and 85° at Chicago. *Missouri:* 95° at *Pierce City and 89° at St. Louis. *Kansas:* 100° at *Fort Wallace and 90° at Leavenworth. *Wisconsin:* 90° at *Beloit and 87° at La Crosse. *Iowa:* 96° at *Boonsboro and 93° at DesMoines. *Nebraska:* 96° at *Howard and 94° at North Platte. *Indian Territory:* 97° at Fort Sill and 94° at Fort Gibson. *Minnesota:* 91° at St. Paul and 86° at Duluth. *Dakota:* 94° at Yankton, 92° Bismarck and 84° at Deadwood. *Colorado:* 89° at *Fort Collins and Denver, and 47° on the summit of Pike's Peak. *New Mexico:* 99° at La Mesilla and 80° at Santa Fe. *Wyoming:* 87° at *Fort Fetterman and 84° at Cheyenne. *Utah:* 87° at *Blue Creek, 80° at Salt Lake City and 75° at *Coalville. *Nevada:* 90° at *Palisade and *Tecoma, 82° at Winnemucca. *Arizona:* 104° at Yuma and Tucson and 101° at Phœnix and Burkes. *Idaho:* 83° at Boise City and 75° at *Fort Hall. *Montana:* 97° at Fort Keogh and 70° at Virginia City. *California:* 108° at *Indio and *Davis, 97° at Los Angeles, 95° at Visalia, 92° at Red Bluff and 83° at San Francisco. *Oregon* 90° at Umatilla and 81° at Roseburg. *Washington Territory:* 75° at Olympia.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Minimum Temperatures.—Maine: 34° at Eastport, *Gardiner and *Surry and 29° at *Orono. *New Hampshire:* 30° at *Dunbarton and —1° on Summit of Mt. Washington. *Vermont:* 27° at Burlington and 26° at *Newport. *Massachusetts:* 35° at Springfield, 33° at Boston and 25° at *South Lee. *Rhode Island:* 37° at Newport. *Connecticut:* 35° at *Southington and New London and 34° at New Haven. *New York:* 34° at New York city and Oswego, 30° at Buffalo and 23° at *Waterbury. *New Jersey:* 32° at *Freehold and *Atco and 30° at *Somerville. *Pennsylvaina:* 28° at *Newcastle and 20° at *Franklin. *Delaware:* 40° at *Dover. *Maryland:* 38° at Baltimore and 33° at *Woodstock. *District of Columbia:* 38° at Washington. *Virginia:* 46° at Cape Henry and 32° at Mt. Solon. *West Virginia:* 36° at Morgantown and 30° at *Helvetia. *North Carolina:* 45° at Wilmington and 34° at Murphy. *South Carolina:* 53° at Charleston. *Georgia:* 50° at Augusta and 44° at Atlanta. *Florida:* 70° at Key West and 54° at *Houston. *Alabama:* 53° at Mobile and 49° at Montgomery. *Mississippi:* 56° at *Fayette and 52° at Vicksburg. *Louisiana:* 63° at *Pt. Pleasant and 54° at Shreveport. *Texas:* 40° at Davis and 34° at Mason. *Ohio:* 33° at Cleveland and *North Lewisburg and 28° at *Westerville. *Kentucky:* 52° at *Bowling Green and 43° at Louisville. *Tennessee:* 40° at Nashville and *Ashwood and 37° at Knoxville. *Arkansas:* 47° at Little Rock and 43° *Mt. Ida. *Michigan:* 29° at Port Huron, 28° at *Hudson and 27° at Alpena. *Indiana:* 40° at Indianapolis and 33° at *Spiceland. *Illinois:* 41° at *Riley and 37° at Chicago. *Missouri:* 44° at St. Louis and 40° at *Ashley. *Kansas:* 44° at Dodge City and 41° at *Cedar Vale. *Wisconsin:* 38° at *Beloit and 31° at *Ripon. *Iowa:* 44° at Dubuque and Des Moines and 37° at *Nora Springs. *Nebraska:* 37° at *De Soto and 29° at *Fort Hartsuff. *Indian Territory:* 52° at Fort Sill and 43° at Fort Gibson. *Minnesota:* 33° at Duluth and Breckenridge. *Dakota:* 31° at Pembina and 27° at Deadwood. *Colorado:* 24° at *Hermosa and 3° on summit of Pike's Peak. *New Mexico:* 28° at Fort Wingate and 24° at Santa Fe. *Wyoming:* 28° at Cheyenne and 23° at *Fort Fetterman. *Utah:* 32° at Salt

Lake City and 25° at *Coalville. *Nevada:* 24° at Winnemucca and 18° at *Otego. *Arizona:* 38° at Wickenburg, 29° at Apache and 27° at Prescott. *Idaho:* 34° at Boise City and 14° at *Fort Hall. *Monvuta:* 27° at *Helena and 23° at Virginia City. *California:* 40° at Red Bluff and Visalia, 39° at Sacramento, 32° at *Tehachapi, 24° at Campo and 18° at *Summit. *Oregon:* 35° at Portland and 33° at Roseburg. *Washingon Territory:* °34 at Olympia.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Ranges of Temperature at Signal Service Stations.—The *monthly ranges* will appear from the maxima and minima just given. The greatest daily ranges vary in New England from 21° at Wood's Holl and 37° at Springfield to 46° at Boston; Middle Atlantic States, 18° at Cape May to 35° at Lynchburg; South Atlantic States, 15° at Cape Lookout, 20° at Savannah to 30° at Wilmington; Eastern Gulf States, 16° at Key West and New Orleans to 26° at Montgomery; Western Gulf States, 15° at Galveston to 28° at Corsicana; Tennessee and the Ohio valley, 24° at Memphis to 34° at Pittsburg; Lower Lake region, 26° at Erie and Buffalo to 37° at Rochester; Upper Lake region, 27° at Grand Haven to 44° at Port Huron and 47° at Duluth and Marquette; Upper Mississippi valley, 27° at Davenport to 41° at St. Paul; Red River of the North valley, 44° at Pembina to 45° at Breckenridge; Missouri valley, 30° at Leavenworth to 43° at Yankton and 47° at North Platte; Texas, 28° at Decatur, Uvalde and San Antonio to 47° at Fort Elliott; Eastern Rocky Mountain slope, 39° at Fort Custer to 41° at Deakwood and 42° at Dodge City; Rocky Mountains, 23° on summit of Pikes Peak to 46° at Helena and Socorro to 49° at Denver; Middle Plateau, 34° at Boise City and Salt Lake City to 40° at Winnemucca; California, 23° at San Francisco to 34° at Red Bluff and 41° at Visalia.

Frost was reported from nearly every State and territory north of the 35th parallel. East of Mississippi it occurred on the following dates: 1st, 2nd, 7th, 8th, 13th, 14th, 15th, 16th, 19th, 21st and 29th, and west of the Mississippi on the 1st, 2nd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 16th, 18th, 20th, 21st, 24th, 25th, 27th and 31st. In many localities severe injury resulted to fruit and vegetables as follows: Fort Collins, Col., 9th, corn and garden crops seriously injured. Southington, Conn., 15th, tender vines blighted. Nile, N. Y., 15th early fruit severely injured. Weldon, N. C., 14th, potato vines injured. Westerville, Ohio, 1st, early fruit damaged. Jacksonburg and Ringgold, Ohio, 1st, fruit injured. Bloominggrove, Pa., 15th, fruit buds and blossoms injured. Litchfield, Pa., 15th, considereble damage to gardens. Windsor, Vt., 15th, early vegetables damaged. Charlotte, N. C., 1st, injuring potato vines. Yamhill County, Or., 11th, garden vegetables generally and wheat in some localities injured.

Ice formed as follows: Roseburg, Or., 13th; Salt Lake City, 6th; Winnemucca, Nev., 31st; Springfield, Mass., 1st; Eastport, 1st; Burlington, Vt., 1st, (15th, ice in Broad Lake ½ inch thick for a distance of three miles off Essex;) New Haven, Conn., 1st; Ft. Collins, Col., 7th, ½ inch; Southington, Conn., 1st; Fallston, Md., 1st, ½ inch; Somerset, Mass., 1st; Fall River, Mass., 1st; Freehold and Linden, N. J., 1st; Ardenia, N. Y., 1st; Waterburg, N. Y., 15th; Palermo, N. Y., 1st, ½ inch; Nile, N. Y., 15th; Bellefontaine and Jacksonburg, Ohio, 1st, Norwalk, Ohio, 1st, three-tenths inch—14th, 15th, one-tenth inch; West Chester, Fallingston and Milton, Pa., 1st; Litchfield, Pa., 1st, ½ inch; Coalville, Utah, 15th, 25th; Charlotteville, Vt., 1st, ice along shore of lake.

Ground Frozen.—Rowe, Mass., and North Volney, N. Y., 1st, quite hard.

PRECIPITATION.

The general distribution of the rain-fall, including melted snow, for May 1880, is illustrated upon chart No. III, as accurately as possible from about 500 reports. In a small table on this chart will be found the average precipitation for the month of May, compared with the precipitation during the present month. Throughout the Atlantic States, except Florida, and in the Missouri valley, the rain-fall has been deficient and severe droughts have resulted in these sections. The heaviest rains have fallen in Alabama, Indiana, Michigan, Indian Territory and Texas; damaging floods occurred in Indiana and Georgia on the 21st and in Texas from the 27th to 29th, details of which will be found below.

Special Heavy Rains.—1st, New Ulm, Tex., 2.31 in; San Antonio, Tex., 2.54 in.; Mason, Tex., 3.64 in. 3rd, Jacksonville, Fla., 2.17 in. Mayport, Fla., 2nd to 4th 5.53 in. 8th, Springfield, Ill., 2.66 in; Peoria, Ill., 3.94 in; Mt. Sterling, Ill, 3.20 in. 9th, Louisville, Ill., 2.70 in. 9th to 11th, Litchfield, Mich., 2.30 in. 8th to 10th, Ashley, Mo., 3.17 in. 9th and 10th, Logansport, Ind., 4.28 in. 10th, Niles, Mich., 2.80 in; Wabash, Ind., 2.15 in. 10th to 11th, Coldwater, Mich., 2.75 in. 11th, Key West, Fla., 3.08 in. 11th to 13th, Gulf Hammock, Fla., 3.55 in. 14th, Ft. Wallace, Kan., 4.00 in. 17th to 18th, Pembina, Dak., 3.18 in. 19th to 21st, Litchfield, Mich., 4.25 in. 20th, Toledo, O., 1.10 in. in 15 minutes; Fort Sill, Ind. Ter., 2.76 in. 20th to 21st, St. Meinrad, Ind., 4.00 in; Louisville, 1.95 in. 21st, Indianapolis, 2.69 in; Montgomery, 3.33 in; Wabash, Ind., 3.20 in; Lansing, Mich., 2.73 in; New Harmony, Ind., 3.33 in. 21st to 22nd, Elsworth, N. C., 5.50 in. in 22 hours. 22nd, Niles, Mich., 3.35 in; Coldwater, Mich., 3.70 in; Columbus, Ga., 9.92 in., 8.50 in. in 10 hours. 23rd, Elsworth, N. C., 2.75 in. 25th to 26th, Tabor, Ia., 2.11 in; Manhattan, Kan., 2.81 in; Breckenridge 4.05 in. 25th to 27th, Mobile, 3.41 in. 26th, Pensacola, Fla., 2.29 in; Pembina, Dak., 2.64 in; Ft. Barrancas, Tex., 4.23 in. 26th to 27th, New Orleans, 3.25 in. 27th, Austin, Tex., 3.00 in. 27th to 28th, Ft. Sill, Ind. Ter., 3.59 in; Nashville, Tenn., 2.25 in. 28th to 29th, Pilot Point, Tex., 3.05 in; St. Meinrad, Ind., 4.50 in; Denison, Tex., 3.04 in. 28th, Boerne, Tex., 6.52 in; Brackettsville, Tex., 12.43 in. 29th to 30th, Tabor, Ia., 3.06 in; Des Moines, 2.91 in; Cincinnati, 2.23 in. Louisville,

3.54 in; Indianapolis, 2.19 in. 30th, Columbus, O., 1.85 in; Chattanooga, Tenn., 1.61 in. in 1 hour, 35 minutes; Vicksburg, Miss., 4.27 in; Laconia, Ind., 2.78 in; Bethel, O., 3.00 in. 30th to 31st, Point Pleasant, La., 4.13 in. 31st, Davenport, 1.60 in. in 3 hours.

Largest Monthly Rain-falls.—Brackettsville, Tex., 13.11 inches; Ft. Barrancas, Fla., 10.98 in.; Elsworth, N. C., 10.43 in.; Ft. Sill, 9.74 in.; St. Meinrad, Ind., 9.55 in.; Coldwater, Mich., 9.40 in.; Wabash, Ind., 8.86 in.; Litchfield, Mich., 8.50 in.; Mayport, Fla., 8.40 in.; Boerne, Tex., 8.29; Logansport, Ind., 8.23 in.; Indianapolis, 8.22 in.; Pembina, 7.98 in.; Cresco, Ia., 7.89 in.; Niles, Mich., 7.87 in.; Key West, 7.84 in.; New Harmony, Ind., 7.72 in.; Alpena, 7.36 in.; Anna, Ill., 7.27 in.; Montgomery, 7.07 in.; Mason, Tex., 7.01 in.; Ashley, Mo., 7.00 in.; Griffin, Tex., 6.42 in.; Jacksboro, Tex., 6.09 in.

Smallest Monthly Rain-falls.—Campo, Cal., and along the Visalia and Yuma divisions of the S. P. R. R., from Sumner to Yuma, (except Keene 0.12, Ravenna 0.10 and White Water 0.01;) Phœnix, Burkes, Grant and Apacha, Ariz.; La Mesilla and Silver City, N. M., and El Paso, Tex., none. Prescott and Yuma, Ariz., trace; Ft. Monroe, Va., 0.02 in.; Ft. Wingate, N. M., and Los Angeles, Cal., 0.04 in.; San Diego, 0.06 in.; Hermosa, Cal., 0.10 in.; Socorro, N. M., 0.14 in.; Stockton, Tex., 0.15 in.; Weldon, N. C., 0.17 in.; Cape Henry, Va., 0.18 in.; Visalia, Cal., 0.28 in.; Winnemucca, 0.29 in.; Cheyenne, 0.44 in.; Somerville, N. J., 0.45 in.; Linden, N. J., 0.46 in.; Brookhaven, N. Y., 0.50 in.; Fayetteville, N. C., 0.53 in.; Norfolk, Philadelphia and Atlantic City, 0.54 in.; Umatilla, Or., 0.57 in.; White Plains, N. Y., 0.58 in.; Woodstock, Md., 0.60 in.; New York City, 0.82 in.

Rainy Days.—The number of days on which rain or snow has fallen, varies as follows: New England, 9 to 23; Middle Atlantic States, 4 to 8; South Atlantic States, 3 to 11; Eastern Gulf States, 12 to 18; Western Gulf States, 5 to 12; Lower Lake region, 6 to 15; Upper Lake region, 10 to 20; Ohio valley and Tennessee, 7 to 12; Upper Mississippi valley, 8 to 18; Lower Missouri valley, 9 to 15; Red River of the North valley, 16 to 18; Eastern Rocky Mountain Slope, 7 to 15; Texas, 1 to 23; Rocky Mountains, 2 to 17; Middle Plateau, 5 to 14; California, 1 to 8; Oregon, 8 to 21; Washington Territory, 12 to 14.

Cloudy Days.—The number varies in New England from 5 to 13; Middle Atlantic States, 1 to 6; South Atlantic States, 1 to 13; Eastern Gulf States, 7 to 13; Western Gulf States, 1 to 7; Lower Lake region, 4 to 7; Upper Lake region, 3 to 11; Ohio valley and Tennessee, 2 to 7; Upper Mississippi valley, 5 to 11; Lower Missouri valley, 5 to 8; Red River of the North valley, 6 to 11; Eastern Rocky Mountain Slope, 4 to 8; Texas, 3 to 10; Rocky Mountains, 0 to 9; Middle Plateau, 0 to 8; California 2 to 7.

Hail was reported from the following States and Territories on the dates named: *Oregon*, 12th. *Washington Ter.*, 5th, 7th. *California*, 12th, two miles north of Red Bluff storm extended over narrow strip ½ mile wide and about two miles long, damaging fruit trees and beating the grain level with the ground. *Idaho*, 5th, 24th. *Nevada*, 12th, 13th. *New Mexico*, 15th, 28th. *Colorado*, 13th, 27th, 28th. *Nebraska*, 4th, 12th, 23rd, 24th. *Kansas*, 8th, 9th, 25th, 30th. *Indian Ter.*, 26th. *Dakota*, 4th, 8th, 14th, 16th. *Wisconsin*, 7th, at Neillsville stones 3½ inches in circumference causing considerable damage, 22nd. *Texas*, 15th, 18th, (28th, 30 miles west of Coleman City violent hail storm destroyed 50 acres of corn.) *Iowa*, 6th, 7th, 8th, 18th, 23rd, 30th. *Minnesota*, 9th, 22nd, 25th, 30th. *Ohio*, 9th 10th 11th, 19th, 20th, 21st, 27th, 29th, 31st. *Illinois*, 8th, 9th. *Indiana*, 10th, 19th. *Louisian* , 25th. *Maryland*, 11th. *Massachusetts*, 6th, 14th. *Missouri*, 26th. *New Hampshire*, 20th, 26th. *New Jersey*, 14th. *New York*, 27th. *Pennsylvania*, 26th. *Vermont*, 6th, 20th. *Virginia*, 14th. Silver City, Iowa, 30th, 5:30 p. m., fearfully black clouds came from the S. NW. and SE., forming a junction west of the town, when the most violent action took place between them, followed by a fall of hail over a strip of country 3 to 4 miles wide and about 12 miles in length. Hundreds of stones fell, measuring 11½ in circumference; some that were picked up one hour after the storm, and at 10 a. m. the next day, were the size of hen eggs. Many were rough, jagged blocks of ice, and two were found that, together, weighed 20 ounces.

Snow.—Snow squalls occurred on the 1st, in *Michigan, Pennsylvania, New York, Connecticut, Massachusetts, Vermont, and New Hampshire.* On the summit of Mt. Washington it fell on the 1st, 2nd, 6th, 12th, 13th, 14th. In *Dakota*, 9th, 16th, 30th. *Montana*, 6th to 9th, 14th, 15th, 24th, 25th. *Wyoming*, 6th, 9th, 30th. *Colorado*, 7th, 9th, 27th, 28th, 31st. On the summitt of Pike's Peak, 1st, 3rd, 7th, 8th, 9th, 16th, 19th, 20th, 22nd, 25th, 26th, 28th, 29th, 31st. *Utah*, 6th, 8th, 9th, 10th, 14th, 23rd, 24th, 25th, 26th, 30th. *Nevada*, 5th, 7th, 12th, 13th, 14th. *California*, 12th, on the coast range, 31st visible on the coast and Sierra Nevada ranges, *Idaho*, 7th, 9th, 14th. *Washington Ter.*, 12th.

Total Monthly Snow-falls.—The following total monthly snow-falls are reported by the C. P. and S. P. R. R. for *May*, 1880:—in the Sierra Nevadas, at Alta, 18 00 inches, Cisco 23.00, Summit, 24.00, Truckee, 6.50, and Boca, 1.00; in Nevada, at Humboldt, 2.50, Battle Mountain, 3.58, and at Beowame and Ivano, 2.00 inches. The observer at Coalville, Utah, reports 14.50 inches.

Floods.—La Crosse, 24th, very heavy rain, rivers and creeks overflowed, trains delayed and considerable damage to property. Castroville, Tex., 29th, rivers and streams overflowed carrying away fences and bridges. Pilot Point, Texas, 27th to 29th, great damage to farming interests. Coleman City, Tex., 28th, 29th, 30 miles west of station unusually heavy rains and destructive floods; Colorado river rose 30 feet during the storm. San Saba, Tex., 27th, very heavy rains, two persons drowned and much property flooded and swept away. Calvert, Tex., 27th, heavy rains, damaging corn, cotton and oats. Brackettsville, Tex., 28th, 1:30 a. m., heaviest and most disastrous rain-storm ever known in this section; all of the

city except portions upon two hills inundated. The water on Main street rose to the height of eight feet; the first floor of every business house from one to five feet under water; many buildings washed away and over twenty persons reported drowned. Lampansas, Tex., heaviest rain for many years; mail stage washed away and driver drowned; much other damage. Vincennes, Ind., 21st, creeks "terribly" swollen; great damage to growing wheat. Fences, bridges, and railroad embankments washed away. A brick-yard near town was submerged and a quarter of a million bricks were washed away. Sullivan, Ind., 21st, severe washouts and much other damage. Huntington, Ind., 21st, Flint Creek overflowed, causing considerable damage, railroad tracks submerged and culverts washed away. Wabash, Ind., 21st, great damage to fences, bridges and crops; stream everywhere overflowed, bottom lands 2 to 10 feet under water; trains delayed. Columbus, Ga., 21st, all railroads broken, no trains running, 67 bridges washed away throughout the county, low lands submerged and all crops damaged; river rose 15 feet in two hours; streets converted into rushing rivers; houses flooded several feet deep; calves, goats, hogs, dogs, and fowl drowned by the score.

Drought.—The following will serve to show the extent of drought in the various sections. Cheyenne, driest month in the past 9 years. Independence, Kan., 28th, first rain in 6 weeks; wheat and oats suffered severely. Bowling Green, Ky., 1st to 20th, exceedingly dry; all crops suffering, oat crop a failure, market gardens seriously damaged. Fallston, Md., 31st, grass and wheat seriously injured; no rain from April 29th to May 22d. Sandy Springs, Md., month unusually dry; all crops suffering. South Lee, Mass., month very dry; "mills on the Housatonic river used all the water on the 24th, an event which has not happened before in 70 years, notwithstanding that the streams have been higher this year than usual." Clear Creek, Neb., 26th, first good rain since last fall; crops suffering. Auburn, N. H., 18th to 30th, very dry; vegetation suffering severely. Freehold, N. J., month unusually dry. Atco, N. J., 31st, strawberry and hay crops seriously damaged. Somerville, N. J., drought very severe throughout the month. White Plains, N. Y., smallest monthly rain-fall in the past 7 years. Catawissa, Pa., throughout month, seriously damaging grain and grass crops. Fallsington, Pa., 22nd, first rain in 23 days; month unusually dry. Litchfield, Pa., 20th, much damage to grain and vegetables. Snowville, Va., 1st to 21st, severe drought. Walnut Grove, Va., no rain from 1st to 21st; crops suffering severely. Norfolk, Va., 28th, unprecedented drought in neighboring country; first and early vegetables damaged to a large extent. Helvetia, W. Va., 1st to 19th, unusually dry; rivers and streams lowest for many years. Omaha, Neb., drought in eastern part of state unprecedented: six months without rain enough to wet the ground; the air is filled with dust.

Rain from a Cloudless Sky.—Burlington, Vt., 10th, 26th.

Precipitation during April, received after the issue of April Review.—Arizona: Whipple Barracks, 0.14 inch.; Fort Lowell, 0.16; Fort Bowie, 0.15; Fort Verde, 0.27; Fort McDowell, 0.28; Fort Apache, 0.46; Fort Grant, 0.04; Fort Mojave, 0.00; Fort Thomas, 0.06. *California:* Benicia Barracks, 8.15; Salinas City, 3.90; Oakland, 8.46; Poway, 3.10; Angel Island, 10.17; Presidio, S. F. Cal., 7.55; Fort Gaston, 13.95; Mount St. Helena, 27.87; San Gorgonio, 6.94; San Buenaventura, 1.87. *Dakota:* Fort Stevenson, 5.66; Fort Sully, 1.71; Fort Meade, 0.75. *Idaho:* Fort Lapwai, 0 23. *Montana:* Fort Benton, 1.80; Fort Shaw, 1.51; Fort Ellis, 4.24; Fort Keogh, 1.10; Fort Logan, 1.45; Fort Assiniboine, 1.29; Blackfeet Agency, 0.91. *Oregon:* Albany, 2.62; Fort Stevens, 4.83; Fort Klamath, 2.77; Eola, 2.21; Fort Harney, 1.70. *Texas:* Fort Ringgold, 0.70; Fort Brown and Fort Davis, 0.00; Fort Elliot, trace; Laredo, 1.20. *Virginia:* Dover Mines. 1.30, *Washington, Ter.:* Fort Canby, 4.03; Fort Townsend, 1.30; Neah Bay, 3.52; Bainbridge Island, 2.15; Dayton, 3.81. *Florida:* Okahumpka, 2.12; Daytona, 2.28. *Massachusetts:* Williamstown, 4.77. *Michigan:* Grand Rapids, 6.00. *Nevada:* Wadsworth, 0.87; Brown's, 0.94. *New Jersey:* South Orange, 3.02. *New York:* Troy, 2.07. *Pennsylvania:* Chambersburg, 3.07. *Tennessee:* McMinnville, 7.50; Austin, 5.38; Clarkville, 5.65; *Utah:* Promontory, 2.03; Terrace, 0.30.

RELATIVE HUMIDITY.

The percentages of mean relative humidity for the month range as follows: New England, from 59.6 to 77.3; Middle Atlantic States, 53.9 to 77.4; South Atlantic States, 58.2 to 77.5; Eastern Gulf States, 71.0 to 77.5; Western Gulf States, 68.9 to 78.3; Ohio valley and Tennessee, 55.1 to 67.9; Lower Lake region, 55.4 to 66.5; Upper Lake region, 59.8 to 75.5; Upper Mississippi valley, 54.3 to 61.6; Missouri valley, 51.1 to 56.4; Red River of the North valley, 65.2 to 67.6; Eastern Rocky Mountain Slope, 41.0 to 85.0; Western Plateau, 10.0 to 49.7: California, 50.6 to 72.0; Oregon, 65.0 to 73.0. *High stations* report the following averages not corrected for altitude: Pike's Peak, 63.5; Mt. Washington, 83.3 per cent.

WINDS.

The *prevailing direction of the winds* for the month of *May*, 1880, is shown, by arrows flying with the wind, on chart No. II. The prevailing winds over the eastern half of the United States were *southerly*, and along the Pacific coast, over the Plateau districts, and in the Upper Missouri valley *northwesterly* or *westerly*. Exceptions to the above generalization are to be found in the northwest winds on the summit of Mt. Washington, at New York, Pittsburg and Marquette; in the northeast winds at Duluth and Jacksonville; in the east winds at Brackettville, McKavett, Indianola, New Orleans, Atlanta, Montgomery, Cedar Keys, Punta Rassa and Key West; and in the southerly winds at Los Angeles and Olympia.

Total Movements of the Air.—The following are the largest total movements at the Signal Service stations: Pike's Peak, 19,287 miles; North Platte, 14,329; Chincoteague, 12,905; Breckenridge, 12,107; Delaware Breakwater, 12,034; Fort Elliott, Tex., 11,948; Dodge City, 11,564; Kittyhawk, 11,504; Stockton, 11,462; Fort Sill, 11,006; Cape May, 10,994; Cape Lookout, 10,826; Wood's Holl, 10,839; Cape Hatteras, 10,707; Bismarck, 10,596; Cape Henry, 10,496; Thatcher's Island; 10,081; Yankton, 9,943; Sandy Hook, 9,855; Concho, 9,788; Barnegat, 9,709; Sandusky, 9,457; Indianola, 9,456; Henrietta, Tex., 9,404; Umatilla, 9,343; Pembina, 9,260; Milwaukee, 9,212; Decatur, 9,047; Grand Haven, 8,832; Philadelphia, 8,367; Cheyenne, 8,354; Omaha, 8,344; San Francisco, 8,320; Cedar Keys, 8,278; Red Bluff, 8,249; Boston, 8,117; St. Paul, 8,115; Key West, 8,039; St. Louis, 8,000. Frost-work prevented a complete record on Mt. Washington. The *smallest are:* Augusta, 2,366; La Mesilla, 2,385; Silver City, 2,442; Deadwood, 2,613; Lynchburg, 2,728; Knoxville, 2,800; Roseburg, 2,882; Shreveport, 2,981; Nashville, 3,050; Tucson, 3,159; Little Rock, 3,327: Des Moines, 3,473; Los Angeles, 3,508; Uvalde, 3,547; Fort Davis, Tex., 3,556; Morgantown, 3,562; Visalia, 3,621; Chattanooga, 3,625; Vicksburg and Laredo, 3,802; Cincinnati, 3,963; Montgomery, 3,997.

Local Storms.—An unusual number of severe local storms were reported during the month. They occurred on the 8th, 9th and 10th, during the passage of low area No. IV, and from the 20th to the 29th, during the passage of low areas Nos. VI, VII, VIII and IX. Kalamazoo, Mich., 8th, 11 p. m.—Violent tornado two miles east of station, demolishing houses, trees and fences; St. Barnabas Chapel, 25 by 40 feet, was moved four feet off from foundation; the cloud appeared to have bounded over many places. Hudson and Thornville, Mich., 8th, very violent wind and rain-storms, causing much damage to buildings and fences. Yates Center, Kan., 9th, 5 p. m., a severe tornado passed from SW. to NE., a few miles north of station; the cloud appeared as a long serpent-like column of dense black smoke; many buildings were destroyed and several persons severely injured. Lincoln county, Mo., 9th, between noon and 1 p. m., a severe tornado started in Highland Prairie, moving in a northeast direction, demolishing trees, fences and buildings; width of path about 200 yards wide. Jacksonville, Ill., 10th, 9 p. m, violent tornado passed along the valley of Big Sandy creek, eight miles south of the town, destroying everything in its path; 20 to 30 buildings were demolished and miles of fencing laid waste; 25 head of cattle and horses, 30 head of sheep, and seven persons were killed; width of path about ¼ mile, and course from SW. to NE. Alsey, Ill., 10th, 7 p. m., a severe tornado; not a dozen houses remained standing within city limits; two black and fearful-looking clouds, one from northwest and the other from southeast met west of the city, from which immediately descended a funnel-shaped cloud, when the work of destruction commenced, and in less than three minutes the entire damage was completed. Arrowsmith, Ill., 10th, very violent wind and rain-storm passed over city during early morning, doing a vast amount of damage to buildings; several persons were dangerously injured; loss estimated at $100,000. Clinton, Ill., 10th, heavy wind and rain-storm during evening; buildings, fences and trees demolished; path very narrow, and course from SW. to NE. Woodlawn, Morgan Co., Ill., 10th, tornado destroyed railroad station and other buildings; four persons killed; path from SW. to NE. Island Pond, Vt., 10th, terrific wind-storm, destroying several buildings, steamboat house and a large covered bridge 200 feet long. Carbondale, Ill., 20th, 2 p. m., violent tornado struck the southern end of the town, unroofing and demolishing houses, and blowing down trees and fences. State Normal University building very seriously damaged. One of the heavy caissons of the artillery park was driven violently for a distance of nearly 100 yards. Course of storm from SW. to NE. Grafton, N. H., 20th, small but violent tornado during afternoon; the largest trees were uprooted or broken off, and fences and buildings damaged. Hail of large size accompanied the storm, some of the stones were pronged shaped, two inches long by one wide. Path of storm from SW. to NE. Wakeman, Ohio, 22d, 5:20 p. m., violent tornado passed through the northern portion of Wakeman township and across Florence and Vermillion townships to Lake Erie, doing a vast amount of damage to dwellings, barns, orchards, timber and fences. "The first evidence of the storm was indicated by a violent conflict of the air currents overhead, driving the clouds in every direction; shortly afterwards a spout like cloud was seen to descent from the clouds to the ground, having a spiral motion from right to left, rapidly assuming greater proportions with increased violence. Solid oak trees, three to five feet in diameter, were twisted off like brittle pipe-stems; animals were carried long distances and dashed in shapeless masses, and poultry were stripped of their feathers and yet found alive. Few trees of any kind were blown over at the roots, being generally twisted off, from four to twenty-five feet from the ground. The funnel-shaped cloud appeard to alternately increase and decrease in size as it moved forward with a swaying motion from side to side. Seen at a distance, the storm-cloud seemed filled with objects resembling immense birds sailing around in the spirally moving current, but which proved to be large branches and pieces of timber." Path, fifteen to thirty rods in width and eight to ten miles in length; course, SSW. to NNE.; loss, $25,000. Freedom, Ohio, 22nd, 7 p. m., severe wind and rain-storm; many buildings crushed to the earth and swept away; miles of fencing and much valuable timber demolished. Omaha, 23rd, 6:15 p. m., small tornado passed through the northern part of the city, from NW. to SE.; width of path about six hundred feet. The catholic convent and several residences were demolished. Immense clouds of dust accompanied the storm, and fence and telegraph wires were blown down in great confusion. At Council Bluffs several buildings were unroofed and freight cars overturned. Mitchell, Dak., 25th, 7 p. m., severe tornado, three persons killed and many buildings destroyed. Most of the farm buildings in the vicinity of the town were blown to pieces. Course of storm from SW. to NE. Independence, Ia., 25th, 4:30 p. m., terrific wind and rain storm, much damage to property. Albany, N.

Y., 26th, 4:25 p. m., very violent wind storm, trees uprooted and fences and buildings demolished. Savoy, Tex., 28th, during the evening this town was almost entirely destroyed by a violent tornado, 15 persons killed and 60 wounded. At Suffield, Conn., on the 29th, about 1:30 p. m., a violent tornado, accompanied with torrents of rain and very heavy hail, passed from SW. to NE. through the township, crossing the Connecticut river directly opposite Thompsonville, where it lifted large bodies of water and demolished boats. In Thompsonville and also through the remaining portion of Enfield township to the eastward the destruction to property was very severe. From 20 to 30 buildings, several fine orchards and groves of choice forest trees were demolished. Width of storm track, about one mile, the boundary lines of destruction on either side being sharply defined, objects in close proximity escaping the slightest injury. In less than 10 minutes from the time the dark clouds were first seen in the west the entire destruction throughout Suffield was completed. The whirling action of the storm cloud was clearly evidenced by the peculiar twisting of the trees from right to left and the spreading of the debris in circles. The loss was estimated at from $30,000 to $40,000.

Sand-storms.—Umatilla, Oregon, 7th; Winnemucca, 2nd, 3rd, 4th, 22nd, 23rd; Burkes, Arizona, 12th, 13th, 22nd, 23rd, 24th, 25th; Colorado Springs, Colorado, 14th; North Platte, 11th, 12th, 13th, 14th; Yankton, 4th; Fort Garland, Col., 6th, 17th, 21st; Fort Union, N. M., 6th, 7th, 9th, 12th, 13th, 14th, 25th.

Waterspouts.—April 23rd, Schooner A. K. Bently in latitude 31°, 59′, N. longitude 79°, 20′, W., reported a remarkable waterspout in the SE., distant about one mile from vessel. It appeared to be an immence volume of water pouring from a dense black cloud. Yates Center, Kan., May 9th, waterspout burst on Vermillion river, 6 miles west of station, raising the water 16 feet in 20 minutes; thousands of fish were killed, not only where the spout burst, but for several miles below. Punta Rassa, Fla., 10th, between 5:50 and 6:05 p. m. a waterspout was seen near Sanibel Island, about two miles from observer, resembling the tall trunk of a cocoanut palm; it was of uniform diameter and brilliant whiteness. Altitude 20° and slightly inclined from the perpendicular at the top towards the east. The base for an apparent distance of 30 or 40 feet, was surrounded by a violently agitated mass of water. The body was a hollow cylinder composed of spray and water ascending with a rapid spiral motion from right to left; it moved from NE. to SW. and vanished from the bottom upwards. On Mustang creek, 4½ miles east of Colorado or Concho river, Texas, on the 28th, a huge waterspout, accompanied by an indescribable hissing, roaring noise, passed down the creek, drowning the horses of a party camped near by, and carrying away all their camp equipage and wagons; thousands of fish were thrown upon the banks.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for May, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 82.8 per cent. The percentages for the four elements are: Weather, 88.3; Direction of the Wind, 81.6; Temperature, 79.0; Barometer, 81.7 per cent. By geographical districts they are: for New England, 77.4; Middle States, 82.6; South Atlantic States, 90.4; Eastern Gulf States, 87.7; Western Gulf States, 86.2; Lower Lake region, 80.6; Upper Lake region, 81.5; Tennessee and the Ohio valley, 83.0; Upper Mississippi valley, 80.7; Lower Missouri valley, 77.3; Northern Pacific region, 84.2; Central Pacific coast region, 85.5; Southern Pacific coast region, 87.5. There were 17 omissions to predict out of 3,813, or 0.45 per cent. Of the 3,796 predictions that have been made, 127, or 3.35 per cent, are considered to have entirely failed; 219, or 5.77 per cent, were one-fourth verified; 430, or 11.33 per cent, were one-half verified; 585, or 15.41 per cent, were three-fourths verified; 2,435, or 64.14 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

Cautionary Signals.—188 Cautionary Signals were displayed during the month, of which 142, or 75 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 33 Off-shore Signals were displayed, of which 27, or 81.8 per cent, were fully justified; 28, or 84.8 per cent, were justified as to velocity and 32, or 97.0 per cent as to direction. 6 of the Off-shore were changed from Cautionary. 221 Signals of both kinds were displayed, of which 169 or 76.5 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 114 cases of winds of 25 miles and over per hour, from scattered stations, were reported, and for which signals had not been ordered.

NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river gauges for the month of May, 1880, with the dates of the same. As a general rule the rivers fell throughout the month. The *Red River*, at Shreveport, and the *Arkansas*, at Little Rock, fell steadily throughout the month. The *Missouri* and *upper Mississippi* changed but little throughout the month. The *Mississippi*, at Cairo, rose three feet from the 1st to the 6th, fell slowly to the 28th, and rose two feet to end of month; at Memphis it rose from the 1st to the 11th, after which it fell to end of month; at Vicksburg the water fell slowly from the 1st to the 5th, and remained almost stationary thence to 15th, on the 15th a more decided fall, which continued to end of month, set in and the water passed below the danger-line on gauge, after having been above that point for a period of 9 weeks; at New Orleans the water fell slowly throughout the month, passing the danger-line on the 26th, after having been above that point

for a period of 11 weeks. The *Ohio*, *Cumberland* and *Tennessee* fell generally throughout the month at all stations.

Ice in Rivers and Harbors.—During the present month Duluth is the only station, within the limits of the Signal Service, reporting interruption of navigation by ice, and the following notes from this station are interesting: On the 1st, steamer *Quebec* made her way through eight miles of ice, which blocked the harbor, and was the first arrival of the season; on the 3rd, steamer *J. L. Hurd* started out, but became blocked in the ice about two miles from shore, and was unable to proceed until the 4th; on the 6th, several vessels were blocked in the ice while coming into port; on the 13th, vessels were still blocked, and the ice in some places was estimated to be forty feet deep, being backed up by strong NE. winds; on the 15th, some vessels succeeded in passing out, and on the 19th, the ice was driven out by strong westerly winds and the lake reported clear.

High Tides.—At Indianola on the 1st, 15th and 16th; on the latter date the water covered the streets, in some places to a depth of 18 inches. At Galveston, 15th, 16th, and 17th; on the 16th many streets were partly under water. At Pensacola, 24th, very high tide.

TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors, with average depth at which observations were taken, is given in the table on the left-hand side of chart No. II. At the following stations observations were not made on the dates indicated: Duluth, 1st to 9th, hindered by ice; San Francisco, 1st to 17th, instrument broken.

ATMOSPHERIC ELECTRICITY.

Thunder-storms—were reported from the various districts on the following dates: New England, 3rd to 7th, 9th, 10th, 19th to 21st, 26th to 28th; Middle Atlantic States, 5th, 9th, 10th, 11th, 14th, 20th to 23rd, 26th, 27th, 28th; South Atlantic States, 4th, 11th, 12th, 22d, 23rd, 24th, 28th and 30th; Eastern Gulf States, 2d, 4th, 10th, 11th, 12th, 13th, 20th, 23rd, 24th to 27th, 29th, 30th, 31st; Western Gulf States, 1st, 2d, 4th, 5th, 12th to 16th, 18th, 19th, 20th, 23rd to 31st; Lower Lake region, 8th, 9th, 10th, 19th to 22d, 26th, 27th, 29th to 31st; Upper Lake region, 5th, 7th, 9th, 10th, 18th, 19th, 23rd, 24th, 31st; Ohio valley and Tennessee, 5th, 9th, 10th, 11th, 12th, 20th, 23rd, 24th, 27th, 29th, 31st; Upper Mississippi valley from 3rd to 31st; Lower Missouri valley, 3rd, 6th, 8th to 19th, 21st, 23rd to 31st; Eastern Rocky Mountain slope, 8th, 9th, 14th, 18th, 19th, 20th, 26th, 28th, 31st; Colorado, 19th and 28th; New Mexico, 28th; Utah, 26th; Wyoming, 3rd; Idaho, 15th; California, 12th at Princeton and Red Bluff; Washington Ter., 7th and 27th.

Auroras.—During May, 1880, three general auroral displays were observed over the United States, namely: on the 1st and 2nd, extending from Eastport, Me. to Montana; on the 14th, extending from New Hampshire and Massachusetts to Lake Superior, and from the 26th to the 28th, from New Hampshire to Montana. The most southerly stations reporting auroras were: Girard, Kans., New Corydon, Ind., and New London on the 1st; Woodstock, Md., on the 4th (very faint) and Cedar Vale, Kans., on the 7th. La Crosse, Wis., 1st, from 8:45 p. m. to midnight; color nearly white; in form of an arch, with lower edge well defined, with centre 10° above horizon. Below arch a dense haze, very dark in color and in striking contrast with the rest of the sky, which was very bright and clear. No beams or columns, merely a diffuse light, quite brilliant at times, nearly disappearing for a few seconds, and reappearing again. Arch extended from about 40° east to 30° west of magnetic meridian. Bismarck, 1st, 9:00 p. m., observed in northwest, extending upward about 30°. Duluth, 1st, 9 p. m., light grayish color, two arches, breaking up about 10 p. m. into beams of light, shooting upward to a great height, some of larger beams reaching to several degrees beyond the zenith. Aurora also observed at 10 p. m. of 2nd. Toledo, 1st, 10:50 p. m., shifting from E. to W. along the north horizon, many streamers reaching to zenith, disappeared at 11:30 p. m. Eastport, 1st, 8:20 p. m. to 2.45 a. m. of 2nd. Burlington, Vt., 2nd, 11:15 p. m. to 12:30 a. m., 3rd, green, dark segment, no arch of light or streamers. New London, 1st, 9 to 11 p. m. Bangor, Me., 2nd, 11:35 p. m. to midnight, very brilliant beams and dancers; altitude 45°; azimuth 75° to 290°. Clear Creek, Neb., 1st, 8 p. m. to 11 p. m., from W. to NE. brightest in NW. Cresco, Ia., 1st, 9:15 p. m., bright low arch in NE. 10 p. m., a few straggling streamers; 10:30 p. m., disappeared; 2nd, 10:30 p. m., a few faint streamers starting from northern horizon. Gardiner, Me., 1st, 9 p. m. to midnight, very bright. 2nd, not very bright; obscured by clouds before midnight. Newburyport, Mass., 2nd, diffuse light above dark segment; a few streamers, no motion, disappeared at 10:20 p. m. Lima, N. Y., 1st, 9:50 to 10:50 p. m., faint, E. three to five streamers. St. Paul, 1st, 10 p. m., dark segment, with luminous arc; continuous motion from to W.; color, pale yellow and orange; remained visible about 40 minutes; telegraph wires perceptibly affected. Pembina, 1st, appeared at 8:30 p. m., and continued throughout night; no continuous arch except for a minute or two, and dark segment scarcely visible. The aurora extended from about 160° to 280° azimuth, with an altitude at various times reaching to the zenith; colors, crimson, yellow and green, very transparent. Breckenridge, 1st, 8 to 10:40 p. m., light green color tinged with red. Burlington, Vt., 14th, from 9 p. m. to 12:30 a. m. of the 15th, light arch of light, pale green. Auburn, N. H., from 9:20 p. m., of 14th, to early morn of 15th. Toledo, 26th, 8:50 p. m., altitude of streamers, 30° to 90°; no lateral motion; disappeared at 11 p. m. Oswego, 26th, 9:15 to 9:50 p. m., NE. to NW.; altitude to zenith; dark segment sur-

mounted by diffuse light from which shot innumerable bright beams. Buffalo, 26th, 9:15 to 9:30 p. m., extending from NE. to NW.; beams having an apparent rapid upward movement to an elevation of about 60°, with a slow lateral movement to the west; color, reddish tinge. Lima, N. Y., 26th, 9:15 p. m., to 10:15 p. m.; streamers 9:37 p. m.; altitude 35°. Bismarck, 27th, from 9 to 10 p. m., altitude about 5°. Trenton, N. J., 8:30 to 8:45 p. m. Burlington, Vt., 28th, from 11:15 to 11:25 p. m., pale green.

Telegraphic Communication Interfered with by Atmospheric Electricity.—Pike's Peak, 19th, 21st; Fort Sill, 26th; Mason, Tex., 1st, 4th, 27th; Boerne, Tex., 28th; Castroville, Tex., 1st, 19th, 20th, 23rd, 24th, 27th, 28th, 29th; Fredericksburg, Tex., 1st, 27th, 29th; Uvalde, Tex., 1st, 19th, 23th, 24th; Laredo, Tex., 23rd, 24th; Stockton, Tex., 4th, 6th, 12th, 13th, 17th, 18th, 19th, 23rd, 24th, 28th, 31st; Davis, Tex., 11th, 14th, 17th; Brackettsville, Tex., 2nd, 23rd, 24th, 28th; Pilot Point, Tex., 28th, 29th; McKavett, Tex., 27th, 28th; Ft. Elliott, Tex., 29th, 31st. On the summit of Mt. Washington, 12th and 26th, St. Elmo's fire appeared on tops of anemometer and anemoscope.

OPTICAL PHENOMENA.

Solar Halos were reported from the various districts on the following dates: New England, 3rd, 4th, 5th, 7th, 8th, 11th, 15th, 18th, 25th, 26th, 28th, 29th; Middle Atlantic States, 1st to 11th, 15th, 19th, 29th; South Atlantic States, 2nd, 5th, 11th, 12th, 22nd, 29th; Eastern Gulf States, 4th, 5th, 6th, 12th, 14th, 16th; Western Gulf States, 1st, 14th, 15th, 17th; Lower Lake region, 2nd to 6th, 9th to 12th, 16th to 20th, 24th, 29th, 31st; Upper Lakes, 1st, 2nd, 6th, 8th, 9th, 20th, 21st, 23rd, 25th, 29th; Ohio valley and Tennessee, 2nd, 4th, 9th, 10th, 11th, 23rd, 26th, 28th, 29th, 31st; Upper Mississippi valley, 1st, 2nd, 8th, 9th to 13th, 18th to 22nd, 25th, 29th; Missouri valley, 1st, 2nd, 5th, 7th to 10th, 15th, 17th to 22nd, 24th, 25th; Middle Plateau, 4th, 7th, 16th, 18th to 21st, 29th; California, 1st, 7th, 13th, 15th, 16th, 23rd, 24th, 29th; Oregon, 1st, 5th, 6th, 10th, 14th, 18th 21st; Washington Territory, 15th, 18th, 19th, 21st.

Lunar Halos were reported from various districts on the following dates: New England, 2nd, 15th, 20th. Middle Atlantic States, 11th, 15th, 17th, 19th to 23rd, 29th. South Atlantic States, 21st to 26th. Eastern Gulf States, 13th to 20th, 23rd, 26th. Western Gulf States, 14th to 23rd. Lower Lake region, 17th, 19th, 23rd, 28th, 29th. Upper Lake region, 13th, 14th, 16th, 19th, 22nd. Ohio valley and Tennessee, 17th, 18th, 28th, 29th. Upper Mississippi valley, 13th, 16th to 20th; Missouri valley, 3rd, 16th to 22nd, 24th. Rocky Mountains, 16th to 21st. Middle Plateau, 17th, 19th, 24th. Pacific coast, 14th, 15th, 17th, 18th.

Mirage.—North Platte, 3rd; Ft. Niagara, N. Y., 4th, 2 p. m.

MISCELLANEOUS PHENOMENA.

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 124 stations show 3,829 observations to have been made, of which 22 were reported doubtful; of the remainder, 3,142 or 82.5 per cent. were followed by the expected weather.

Zodiacal Light.—Wabash, Ind., 1st to 7th, 12th. Yate's Centre, Kan., 2nd, 3rd, 5th, 6th, 7th, 29th. Harvard College, Cambridge, Mass., looked for every clear evening but none seen; evenings of the 2nd, 6th, 8th and 10th were the only ones when the presence of the light could have been seen. Somerset and Fall River, Mass., 2nd. Oregon, Mo., 1st, 2nd, 3rd, 6th, 7th, 8th. Clear Creek, Neb., 2nd. Atco, N. J., 2nd, 3rd, 4th, 5th, 9th, 10th, 25th. Bellefontaine, Ohio, 1st, 3rd to 8th, 11th. Walnut Grove, Va., 3rd, 4th, 7th, 25th. Mr. Chas. Hasselbrink, at Havana, reports "cloudiness and moonshine have been a great hindrance to observations on the zodiacal light during the whole month of May, 1880." The zodiacal light was visible on the following dates: 1st and 2nd, of great extension, intermittent. 25th, 8 to 9 p. m., of great lateral extension and exceedingly bright; relative humidity, 78 per cent. 28th, 8:30 to 9:45 p. m., exceedingly bright and of great azimuthal extension, with the line of axis strongly inclined to the left (south); relative humidity, 82 per cent. Mr. Hasselbrink, in forwarding the above, observes "this concurrence of facts, namely, brightness, extension and humidity, strengthens my belief that the light is more visible in damp than in dry weather."

Meteors.—San Francisco, 6th, 9:30 p. m., very brilliant, course SE. to NE., burst with a loud report and with a gorgeous display of colors. North Platte, 8th. Pensacola, Fla, 6th, 7th, 9th, 24th, 28th, 31st. Little Rock, Ark., 5th, 11th, 25th, 30th. Cedar Keys, Fla., 30th. Boise City, 19th. Knoxville, 12th. Ft. Dodge, Ia., 13th, 9 p. m. Yates Center, Kan., 20th. Point Pleasant, La., 9th. Woodstock, Md., 9th, 25th, 26th, 27th. Fall River, Mass., 26th. Fayette, Miss., 5th. Corning, Mo., 27th, 31st. Clear Creek, Neb., 28th.

Prarie and Forest Fires.—Milford, Pa., 12th to 14th, "terrible forest fires," over 3 million feet of lumber, a vast amount of valuable timber and several houses and barns destroyed. Atlantic Co., N. J., 14th, the loss by fires in this county on live stock, buildings, timber, &c., is estimated at $200.000 not including the loss of $20.000 on the vineyard around Egg Harbor City. In Galloway township 30 buildings were burned. Gibson's Mills, N. J., 14th, scarcely an acre of timber land for miles around which has not been swept by fire, many dwellings and outbuildings burned. Alison, N. J., 14th, over 100 square miles of valuable berry-bogs, timberland and vineyards, have been destroyed. At the village of Great Republic, 22 buildings

were burned. In Ocean, Monmouth, Burlington and Cumberland Cos., the fires have been exceedingly destructive; over 18,000 acres of cedar and large tracks of vineyards have been destroyed. Observed from Pike's Peak, 5th, 11th, 12th, 13th, 14th, 16th, 17th, 24th. Colorado Springs, 15th, 24th. North Platte, 7th. Ft. Dodge, Ia., 1st, 3rd. Independence, Kan., 1st to 27th. Freehold, N. J., 6th, 9th, 10th, 12th, 15th, 16th, 17th. Atco, N. J., 6th, 12th. Walnut Grove, Va., 8th to 19th, 21st, 23rd.

Polar Bands.—Portland, Or., 12th, 17th; Riley, Ill., 14th; New Corydon, Ind., 1st, 6th, 11th, 13th, 14th, 23rd, 24th; Guttenburg, Ia., 20th; Clear Creek, Neb., 30th; Auburn, N. H., 29th; Walnut Grove, Va., 2nd.

Earthquakes.—Pt. San Jose, Cal., 5th, 11:35 p. m., slight shock. San Francisco, 5th, 11 p. m., sharp shocks in various parts of city; motion from south to north and then vertical. Newburyport, Mass., 12th, 7:45 a. m., violent shock, houses shook in many parts of the city, the accompanying noise resembling that of a heavy barrel rolling over a chamber floor. Shocks were felt at the same time in Haverhill, Groveland and surrounding towns. Billerica, Mass., 12th, slight shock at 7:30 a. m.

Locusts.—Morgantown, W. Va., 18th, first re-appearance of 17 year locusts. Their successive appearance at this station is reported as follows: May 15th, 1795; May 25th, 1812; May 25th, 1829; May 14th, 1846; May 25th, 1853; May 1[illegible]th, 1880. Cedar Vale, Kan., 23rd, distructive western locust in considerable numbers.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent, Nautical Almanac Office, Washington, D. C.:

Date—May, 1880.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
1st, 8 a. m...	0	0	0	0	0	0	1	20†	Many of the spots small.
2nd, 12 m.....	1	5	0	0	1	5	2	20†	Faculæ.
3rd, 8 a. m...	0	5	0	5	0	5	2	20†	
4th, 8 a. m...	0	0	0	3	0	0	2	17†	Faculæ.
5th, 5 p. m...	0	0	0	5	0	0	2	12	Broad areas of faculæ.
6th, 8 a. m...	0	0	1	1	0	0	1	10	Faculæ.
7th, 9 a. m...	1	4	0	0	0	0	2	14	Faculæ.
9th, 10 a. m...	0	0	0	0	0	0	2	12	
13th, 12 m.....	0	0	.....	.....	0	0	1	2	
17th, 3 p. m...	0	0	1	2	0	0	0	0	
18th, 6 p. m...	0	0	0	0	0	0	0	0	
20th, 4 p. m	1	7	0	0	0	0	1	7	Spots small.
21st, 4 p. m...	0	0	0	0	0	0	1	2	Faculæ.
24th, 6 p. m...	2	8	.....	.....	1	5	2	8	Broad areas of faculæ.
25th, 4 p. m...	1	12	0	0	0	0	3	20†	Faculæ. Many of the spots small.
26th, 5 p. m...	0	6	0	6	0	6	2	22†	Faculæ. Many of the spots small.
27th, 4 p. m...	0	5	0	0	0	0	1	25†	Faculæ. Many of the spots small.
31st, 8 p. m...	1	2	0	0	1	2	2	27†	Faculæ. Many of the spots small.

†Approximated.

Mr. Wm. Dawson, at Spiceland, Indiana, reports:—1st, 3 groups, 60 spots. 2nd, 3 groups, 34 spots. 3rd, 3 groups, 22 spots. 5th, 3 groups, 30 spots. 6th, 2 groups, 17 spots. 7th, 3 groups, 28 spots. 8th, 2 groups, 24 spots. 12th, 3 groups, 11 spots. 13th, 2 groups, 11 spots. 14th, 2 groups, 4 spots. 15th and 17th, no spots. 16th, 1 group, 4 spots. 19th, 2 groups, 5 spots. 23rd, 1 group, 2 spots. 27th, 1 group, 40 spots. 28th, 1 group, 50 spots. 30th, 2 groups, 63 spots. 31st, 2 groups, 43 spots.

Mr. H. D. Gowey, at North Lewisburg, Ohio, reports:—26th, 8:30 a. m., two large and several small spots N. of equator and near E. side. 27th, 7:45 a. m., two large spots and several groups. 29th, 7:45 a. m., two very large and several groups of smaller spots.

Mr. F. Hess, at Fort Dodge, Ia., reports: 1st, six large spots, each accompanied by a number of smaller ones, and some faculæ on sun's upper half. 2nd, 6 a. m., same group in NW. quarter, and a new spot near E. limb. 3rd, 8 a. m., one large spot and faculæ in NE. quarter; only three spots of the other group remain distinctly visible. 4th, only one large spot—too windy and hazy for distinct vision. 5th, 8 a. m., one very large spot with broad penumbra and a cluster of very minute spots beneath in NE. quarter; also two small spots and many faculæ in NW. quarter. From the 6th to 13th, same group of one large and a cluster of small spots looking like a bunch of grapes suspended from penumbra of large spot, and some faculæ visible until 13th when the cluster consolidated into one large spot. 14th, no spots or faculæ. 15th and 16th, no spots, faculæ in SE. quarter. 17th and 18th, no spots or faculæ. 20th and 21st, two large and a number of smaller spots amid faculæ in NE. quarter, between 3′ to 5′ from NE. limb; at noon of the 21st only one spot about 8′ from NE. limb which had also disappeared by 6 p. m. 22nd and 23rd, no spots or faculæ. From the 25th to 31st, a fine group of twenty or more spots, of which five quite distinct and one very large, undergoing various changes while advancing on upper half of sun's disk. A new spot and group of faculæ appeared in SE. quarter on the 30th.

NOTES AND EXTRACTS.

[*From Nature, April* 8, 1880.]

On the Long Period Inequality in Rainfall.[1]—1. If it be true that there is a variation in the power of the sun depending on the state of his surface, this variation might naturally be expected to make itself apparent through a corresponding change in the rainfall of the earth, so that when the sun is most powerful there ought to be the greatest rainfall.

2. While the connection indicated above is that which most readily occurs to the mind, yet the difficulty of ascertaining the facts of the case in a manner bearing the smallest approach to completeness, is so great as to be at present insuperable. There is, *first of all*, an intense reference to locality in rainfall, so that the rainfall at one place may differ greatly from that at another place in its near neighborhood. *Again*, there are, probably, in addition to possible secular inequalities, very great oscillations in the yearly rainfall at any one place, or accidental variations as we may term them, in our ignorance of their cause. *Thirdly*, it is in comparatively few places, and those places chosen not with the smallest reference to this particular problem, that we have anything like a trustworthy account of the rainfall throughout a considerable number of years. *Fourthly*, we have no information of any importance with respect to the rainfall at sea.

3. Besides the formidable catalogue of difficulties now mentioned, we ought to bear in mind the following considerations. The convection currents of the earth are regulated by two things, one of which is constant, while the other may be variable. The constant element is the velocity of rotation of the earth on its axis, while the element of possible variability is the power of the sun. Hence it follows that if the sun be variable it will cause a variation in the direction as well as in the intensity of the earth's convection-currents on the principle which tells us that the resultant of two forces, one constant and the other variable, must vary both in magnitude and direction. Now if it be true that we have a long period variation, not merely of the intensity, but also of the distribution of the earth's convection-currents, and if we bear in mind the intensely local reference in rainfall, it would be too much to expect that the rainfall inequality should exhibit the same years of maximum and minimum at all places. It is even conceivable that some places might exhibit a maximum when others showed a minimum, while others again might exhibit a double instead of a single period.

4. It appears to me that if we bear in mind these considerations, it will not answer to add together the rainfalls of a few selected stations as they stand, with the view of determining by this means whether there be a long-period inequality in the rainfall of the *whole earth*. We are not yet in a position to reply experimentally to this question. It does not, however, follow that nothing can be done. Dr. Meldrum and others appear to have achieved good preliminary work in the direction of indicating the existence of a rainfall inequality depending upon the state of the sun. Dr. Meldrum began by pointing out that in a good many places there is a greater rainfall during years of maximum than during years of minimum sun-spots, and that this phenomenon repeats itself from one solar cycle to another. Again, Governor Rawson has pointed out the existence of certain localities where the rainfall inequality appears to be of a precisely opposite character, while Dr. Hunter has shown the practical importance of the investigation with reference to certain tropical stations. The subject has likewise been discussed by Piazzi Smyth, Stone, and others.

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1 By Balfour Stewart, LL.D., F.R.S., Professor of Natural Philosophy at the Owens College, Manchester. Being a paper read before the Lit. and Phil. Society of Manchester.

[*From Nature, May* 13, 1880.]

The United States Weather Maps, August, 1878.—The most remarkable feature of the meteorology of the northern hemisphere for August, 1878, as compared with July preceding, was the enormous change which took place in the distribution of atmospheric pressure over the Atlantic as far as lat. N. 60°, the change being greatest in the region around Ireland and the southwest of England, where it amounted to a fall of about the third of an inch. Pressure was also still further reduced over nearly the whole of the United States, particularly in the north, the deficiency from the normal at New York being over 0.150 inch. In Europe, this lowering of the pressure extended eastward into Russia as far as long. E. 40°, where it rose to nearly the average. It again fell on advancing further eastward to 0.150 inch below the normal in the valley of the Irtish, rising however again to the normal over the western affluents of the Lena. Thus from the Rocky Mountains, across the United States, the Atlantic, Europe and into Asia as far as the Lena, pressure was under the normal, in other words over a broad belt going half-way round the globe. This region of abnormally low pressure would appear to have stretched south-south-westward from Western Siberia, embracing the regions marked off by Syria, Egypt, Africa as far as Cape Colony, the Maritius, Western India and Turkistan. Also in Victoria, Tasmania and New Zeland pressure was very low, being at Dunedin 0.372 inch less than the normal.

In accordance with this distribution of pressure, temperature was from one to two degrees above the normal in the United States, except in the Northeast, where it fell to the average in the New England States, and fell still further to 1°.6 below it at St. John's, Newfoundland. Under the influence of the low pressure around Ireland the Weather Map shows a prevalence of strong breezes from the Atlantic over Western, Central, and Eastern Europe as far as Kiev, and over the whole of this wide region temperature was above the normal, most notably so over Great Britian and the south of Norway, the mean at Mandal being 4°.2 above the average.

Over England these Atlantic breezes were southwesterly, but in Scotland easterly. In England the month was one of the rainiest Augusts on record, and in the east of Scotland the rains were also unusually heavy. On the other hand, what invariably happens when the weather in the east of Scotland is characterised by rain and east winds, the weather of the West Highlands was dry and bright.

[*Popular Science Monthly and Comptes Rendus.*]

Observations made by M. Fautrat in France for four years as to the rain-fall over forests and over treeless tracts are as follows: That it rains more abundantly over forests than over open ground, especially when the trees are in leaf; that the air above the forest is more saturated with moisture than over the open

ground; that the leaves of trees intercept one-third, and in some trees one-half of the rain-fall, and that the leaves and branches restrain the evaporation of the water that reaches the ground, moistening the earth four times as much as it is moistened by the rain that falls on open ground. With respect to the kind of forest, M. Fautrat states that in 1878 the rain-fall collected above folious (leafy) trees was 30.5 inches and in the vicinity of the forest on the open ground 29.7 inches. The difference in the favor of the forest is 0.8 inches. During the same time there fell on the top of pines 30.5 inches of water and on the plain at the same altitude 28.6 inches, a difference in favor of pines of 1.9 inches. Forests, and above all, resinous woods have the remarkable property of extracting from the rain bearing currents that cross them a greater volume of rain-fall than open grounds.

[*La Nature.*]

Winter of 1879 *and* 1880, *at Clermont and Puy-de-Dome, France.*—M. Alluard, Director of the Observatory at Puy-de-Dome, presents some curious observations upon the comparison of temperatures at Clermont and at the summit of Puy-de-Dome. [The summit of Puy-de-dome is 3,540 feet above Clermont.] The winter of 1879 and 1880 was the most rigorous known in Auvergne. In the day-time a minimum temperature of —9.°4 was once experienced. The mean temperature of the month of December was +19.°9. While thick fog for days covered Clermont the weather at Puy-de-Dome remained very clear and the mean temperature was 18° higher at Puy-de-Dome than at Clermont. The inversion of temperatures between Clermont and Puy-de-Dome, previously remarked by M. Alluard, have been very frequent. They are shown whenever a zone of high pressure covers Europe, and the differences are greater as the pressures are higher. Thus a comparison of thermometers shows when an anti-cyclone is present in France or in Europe. It would be well to know at what height these inversions are first manifested.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

Brigadier General, Chief Signal Officer, U. S. A.

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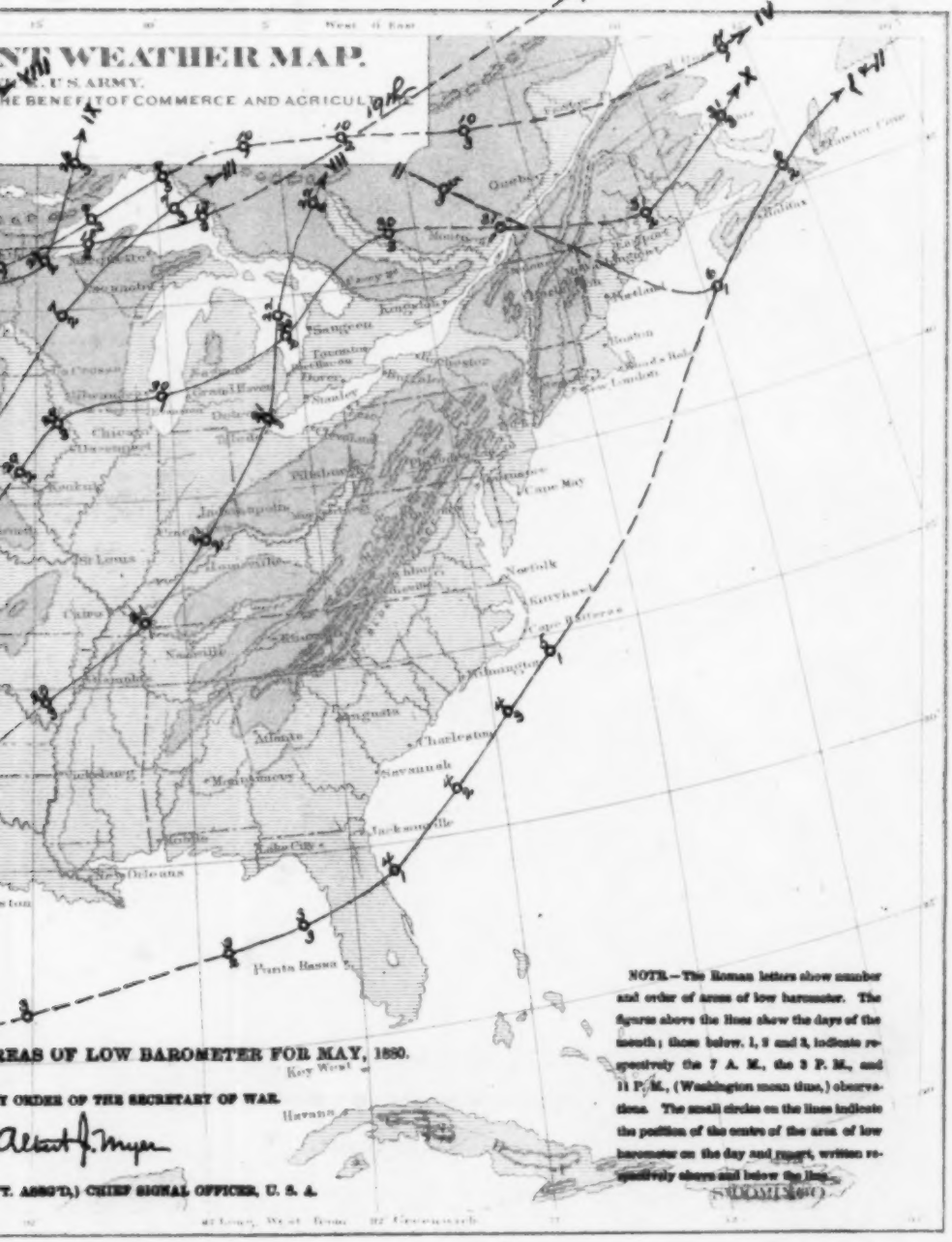
WAR DEPARTMENT W
SIGNAL SERV
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENE
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER EAST OF THE 107TH MERIDIAN.
No.
Velocity.
I. 30 miles per hour.
II. — do.
III. 19 do.
IV. 32 do.
V. — do.
VI. 22 do.
VII. 30 do.
VIII. — do.
IX. 14 do.
X. 26 do.
TRACKS OF CENTRES OF AREAS OF
PUBLISHED BY ORDER O
BRIG. GEN., (BVT. ASST'D.)

No. I.



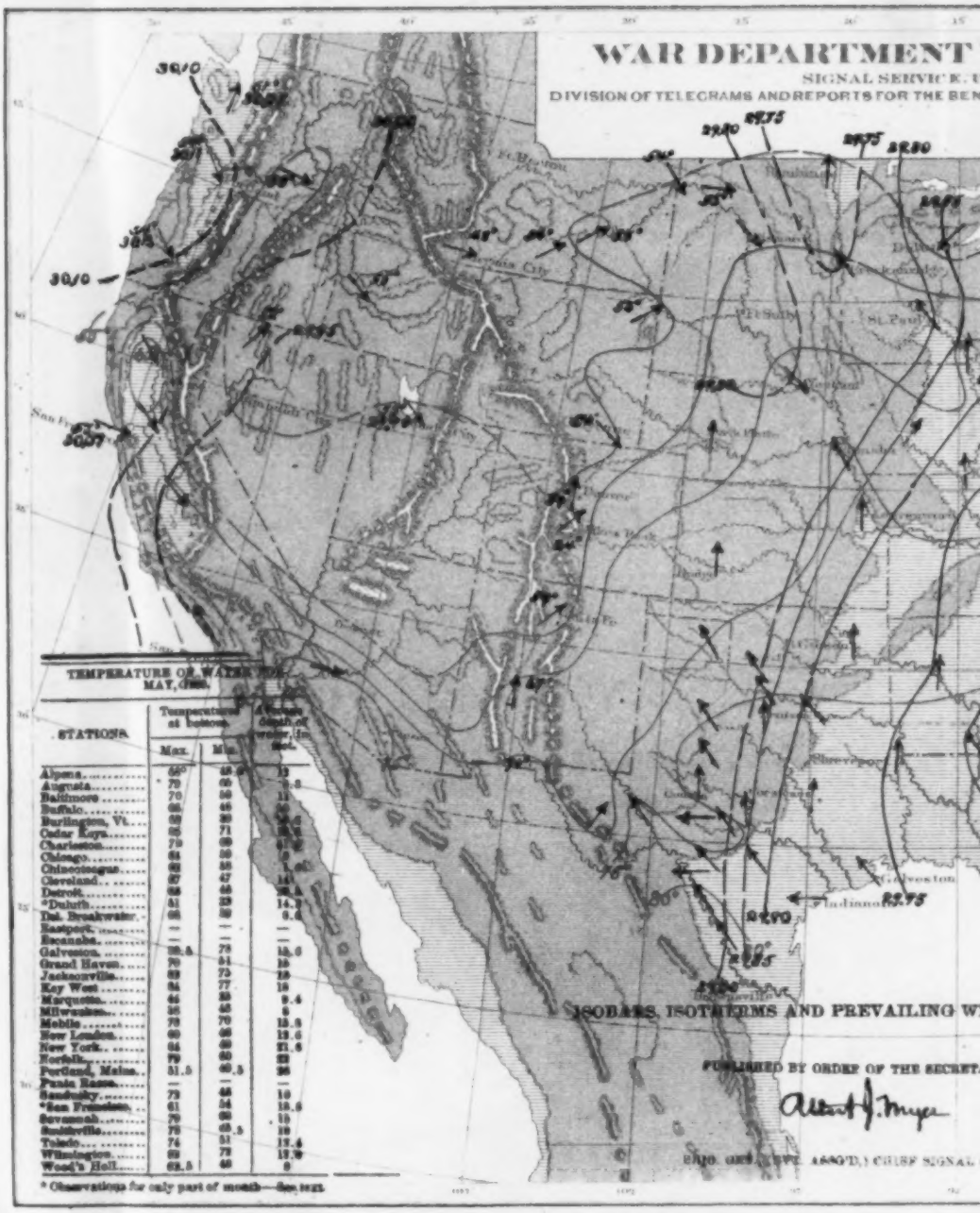
REAS OF LOW BAROMETER FOR MAY, 1880.

NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 2 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.

Y ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

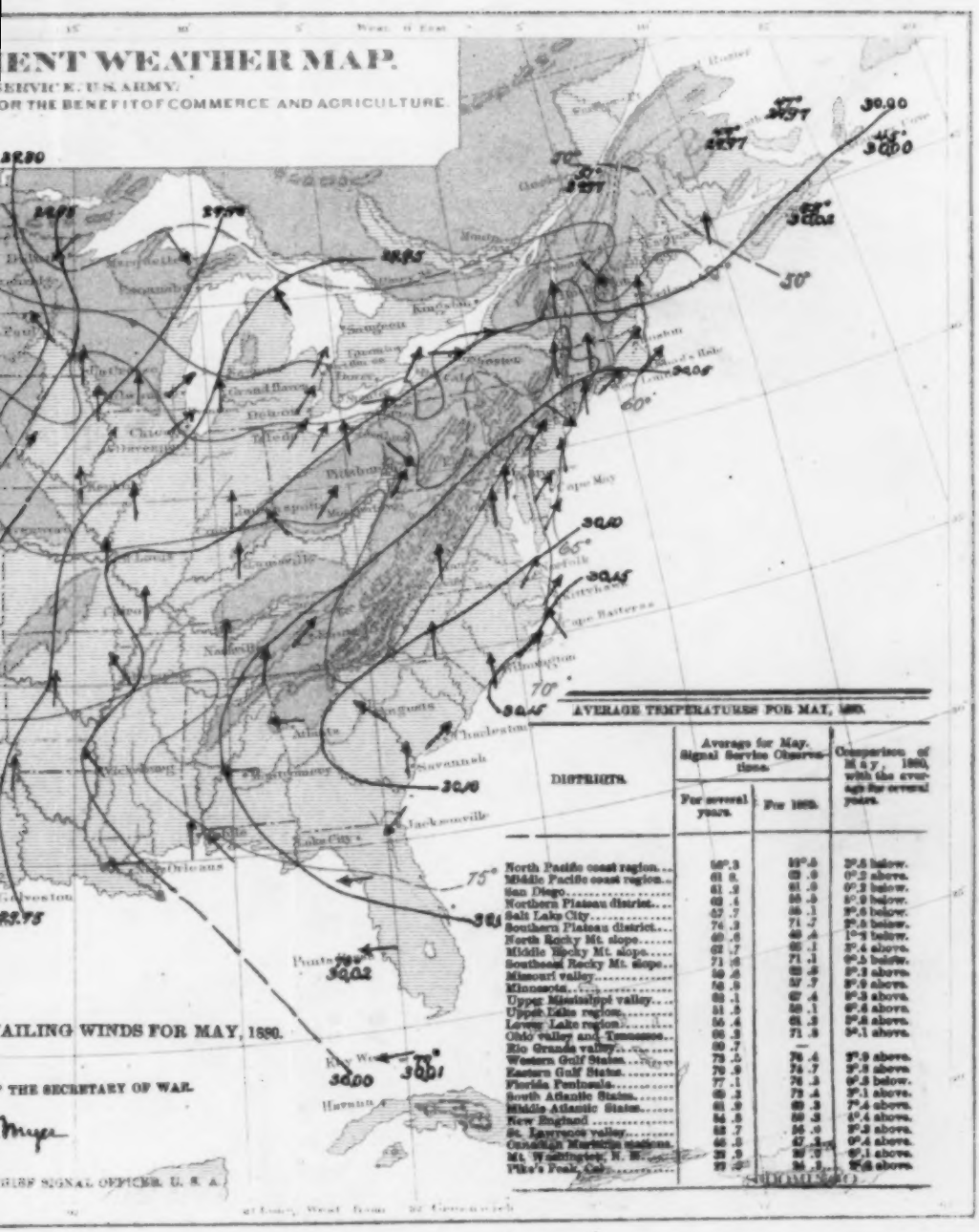
T. ASST'L) CHIEF SIGNAL OFFICER, U. S. A.


WAR DEPARTMENT
SIGNAL SERVICE, U
DIVISION OF TELEGRAMS AND REPORTS FOR THE BEN
ISOBARS, ISOTHERMS AND PREVAILING W
PUBLISHED BY ORDER OF THE SECRET
Albert J. Myer
SIGNAL OFFICER, U.S.A. (ASS'T.) CHIEF SIGNAL

TEMPERATURE OF WATER [illegible]
MAY, 1880.

STATIONS.	Temperature at Sunrise.		Average daily range of temperature.
	Max.	Min.	
Alpena	66°	48°	12
Augusta	70	46	7.3
Baltimore	70	46	13
Buffalo	66	46	8.6
Burlington, Vt.	69	46	13.5
Cedar Keys	85	71	13.3
Charleston	75	60	6.2
Chicago	64	46	9
Chincoteague	69	48	9.6
Cleveland	67	47	14
Detroit	68	46	14.4
*Duluth	51	32	14.7
Dul. Breakwater	66	39	9.4
Eastport	—	—	—
Escanaba	—	—	—
Galveston	88.5	72	15.6
Grand Haven	70	54	15
Jacksonville	82	72	10
Key West	84	77	10
Marquette	64	42	9.4
Milwaukee	66	46	9
Mobile	78	70	13.3
New London	66	46	13.6
New York	64	46	11.6
Norfolk	79	60	12
Portland, Maine	51.5	40.5	26
Punta Rassa	—	—	—
Sandusky	73	44	19
*San Francisco	61	54	13.6
Savannah	79	60	15
Smithville	79	60.5	19
Toledo	74	51	17.4
Wilmington	69	73	17.9
Wood's Holl	62.5	40	9

* Observations for only part of month—See text.


ENT WEATHER MAP.
SERVICE, U.S. ARMY.
FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
AILING WINDS FOR MAY, 1880.
THE SECRETARY OF WAR.
SIGNAL OFFICER, U. S. A.

AVERAGE TEMPERATURES FOR MAY, 1880.

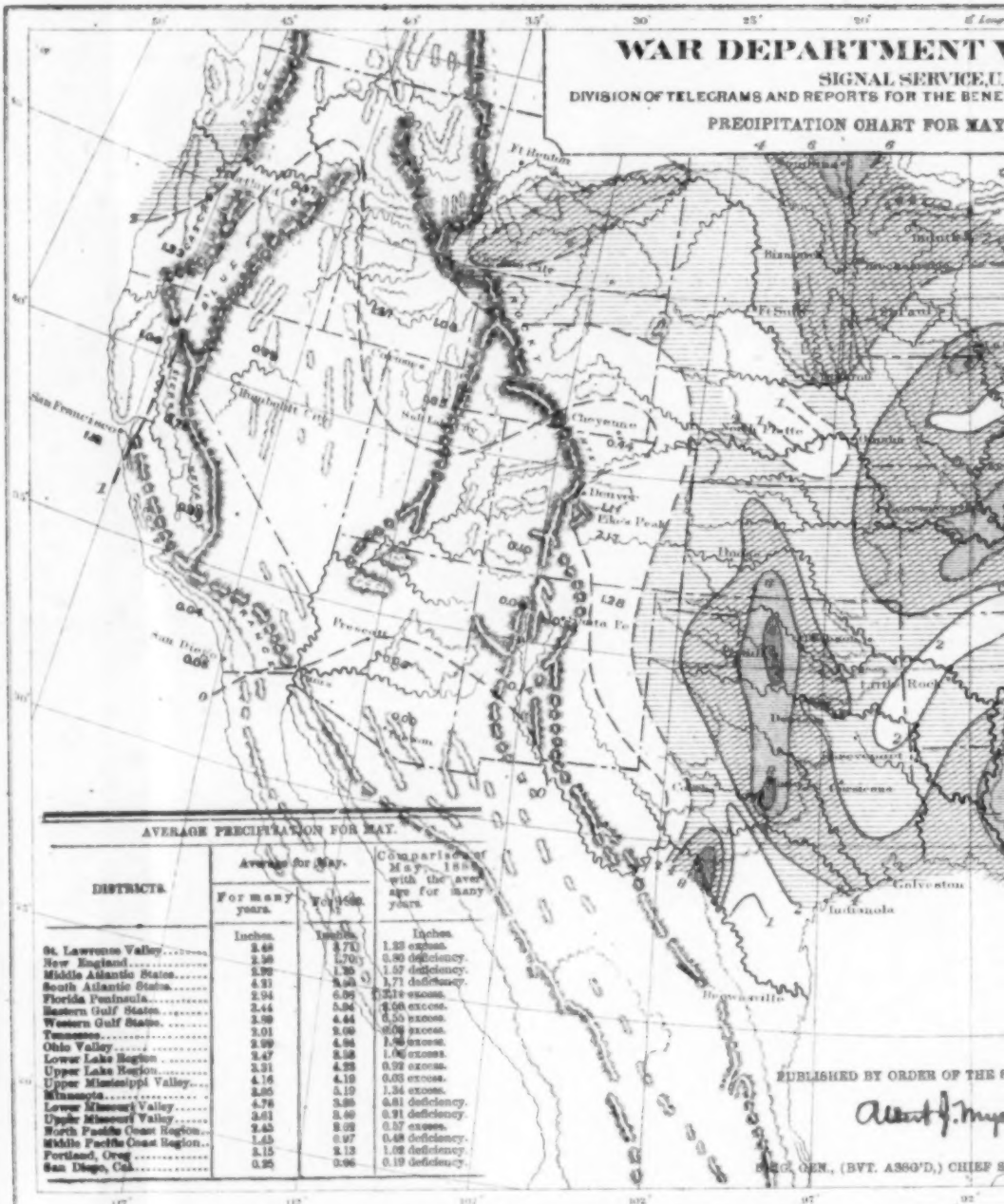
DISTRICTS.	Average for May. Signal Service Observations.		Comparison of May, 1880, with the averages for several years.
	For several years.	For 1880.	
North Pacific coast region	56°.3	53°.5	2°.8 below.
Middle Pacific coast region	61 .6	62 .0	0°.2 above.
San Diego	61 .2	61 .0	0°.2 below.
Northern Plateau district	63 .4	55 .5	8°.9 below.
Salt Lake City	57 .7	55 .1	2°.6 below.
Southern Plateau district	74 .3	71 .7	2°.6 below.
North Rocky Mt. slope	49 .8	48 .4	1°.4 below.
Middle Rocky Mt. slope	62 .7	66 .1	3°.4 above.
Southeast Rocky Mt. slope	71 .6	71 .1	0°.5 below.
Missouri valley	59 .6	62 .9	3°.3 above.
Minnesota	50 .8	57 .7	6°.9 above.
Upper Mississippi valley	63 .1	67 .4	4°.3 above.
Upper Lake region	51 .5	59 .1	6°.6 above.
Lower Lake region	56 .4	61 .2	4°.8 above.
Ohio valley and Tennessee	66 .2	71 .3	5°.1 above.
Rio Grande valley	80 .7	—	—
Western Gulf States	73 .5	76 .4	2°.9 above.
Eastern Gulf States	70 .9	74 .7	3°.8 above.
Florida Peninsula	77 .1	76 .3	0°.8 below.
South Atlantic States	69 .3	73 .4	3°.1 above.
Middle Atlantic States	61 .9	66 .3	7°.4 above.
New England	54 .5	59 .3	4°.4 above.
St. Lawrence valley	52 .7	56 .0	3°.3 above.
Canadian Maritime stations	46 .3	47 .1	0°.4 above.
Mt. Washington, N. H.	21 .9	22 .0	0°.1 above.
Pike's Peak, Col.	19 .2	24 .1	4°.9 above.

WAR DEPARTMENT

SIGNAL SERVICE, U.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENE

PRECIPITATION CHART FOR MAY



AVERAGE PRECIPITATION FOR MAY.

DISTRICTS.	Average for May.		Comparison of May, 1880, with the average for many years.
	For many years.	For 1880.	
	Inches.	Inches.	Inches.
St. Lawrence Valley	3.48	4.71	1.23 excess.
New England	2.56	1.70	0.86 deficiency.
Middle Atlantic States	2.92	1.35	1.57 deficiency.
South Atlantic States	4.21	2.50	1.71 deficiency.
Florida Peninsula	2.94	6.32	3.38 excess.
Eastern Gulf States	3.44	5.04	1.60 excess.
Western Gulf States	3.99	4.44	0.55 excess.
Tennessee	2.01	2.09	0.08 excess.
Ohio Valley	2.99	4.96	1.97 excess.
Lower Lake Region	3.47	4.53	1.06 excess.
Upper Lake Region	3.31	4.23	0.92 excess.
Upper Mississippi Valley	4.16	4.19	0.03 excess.
Minnesota	3.85	5.19	1.34 excess.
Lower Missouri Valley	4.76	3.95	0.81 deficiency.
Upper Missouri Valley	3.61	2.70	0.91 deficiency.
North Pacific Coast Region	2.45	2.82	0.37 excess.
Middle Pacific Coast Region	1.45	0.97	0.48 deficiency.
Portland, Oreg	3.15	2.13	1.02 deficiency.
San Diego, Cal	0.25	0.06	0.19 deficiency.

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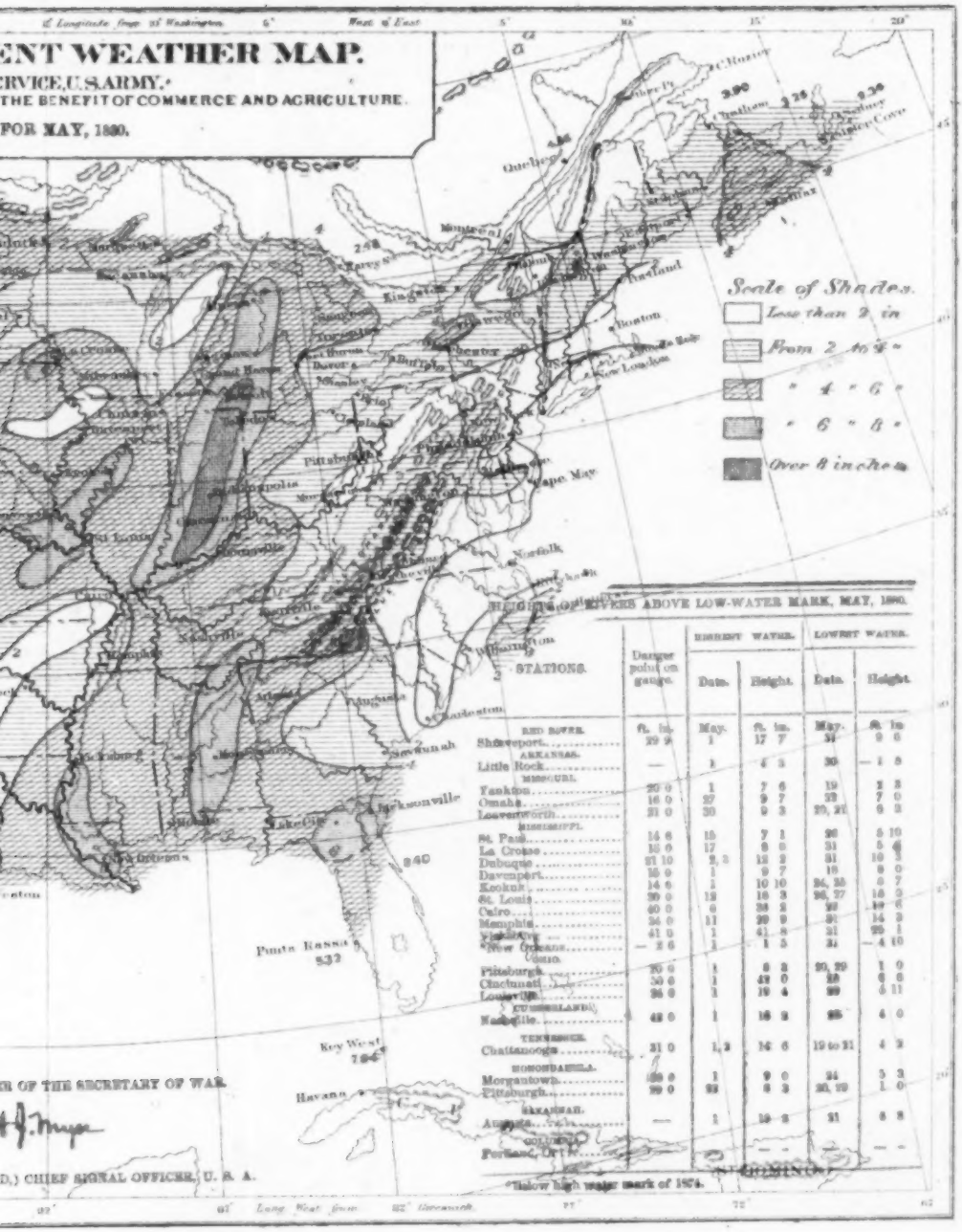
BRIG. GEN., (BVT. ASS'T'D,) CHIEF S

ENT WEATHER MAP.

ERVICE, U.S. ARMY,

THE BENEFIT OF COMMERCE AND AGRICULTURE.

FOR MAY, 1880.



RIVERS ABOVE LOW-WATER MARK, MAY, 1880.

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
RED RIVER.	ft. in.	May.	ft. in.	May.	ft. in.
Shreveport	29 9	1	17 7	31	9 6
ARKANSAS.					
Little Rock	—	1	4 5	30	— 1 8
MISSOURI.					
Yankton	20 0	1	7 6	19	2 3
Omaha	16 0	27	9 7	28	7 0
Leavenworth	21 0	30	9 3	20, 21	6 3
MISSISSIPPI.					
St. Paul	14 6	15	7 1	26	5 10
La Crosse	16 0	17	9 6	31	5 6
Dubuque	21 10	2, 3	12 2	31	10 1
Davenport	15 0	1	9 7	16	8 0
Keokuk	14 6	1	10 10	24, 25	6 7
St. Louis	30 0	12	16 3	26, 27	14 3
Cairo	40 0	6	38 2	22	19 6
Memphis	34 0	11	20 9	31	14 3
Vicksburg	41 0	1	41 8	31	22 1
*New Orleans	— 2 6	1	1 5	31	— 4 10
OHIO.					
Pittsburgh	25 0	1	6 2	20, 29	1 0
Cincinnati	50 0	1	42 0	18	6 6
Louisville	38 0	1	19 4	29	5 11
CUMBERLAND.					
Nashville	42 0	1	16 2	25	4 0
TENNESSEE.					
Chattanooga	31 0	1, 2	14 6	19 to 21	4 3
MONONGAHELA.					
Morgantown	28 0	1	9 0	24	3 3
Pittsburgh	20 0	23	8 3	20, 29	1 0
SAVANNAH.					
Augusta	—	1	10 2	31	6 8
COLUMBIA.					
Portland, Or.		—	—	—	—

*Below high water mark of 1874.

Punta Rassa 832

Key West 784

Havana

Pensacola 240

R OF THE SECRETARY OF WAR.

D.) CHIEF SIGNAL OFFICER, U. S. A.

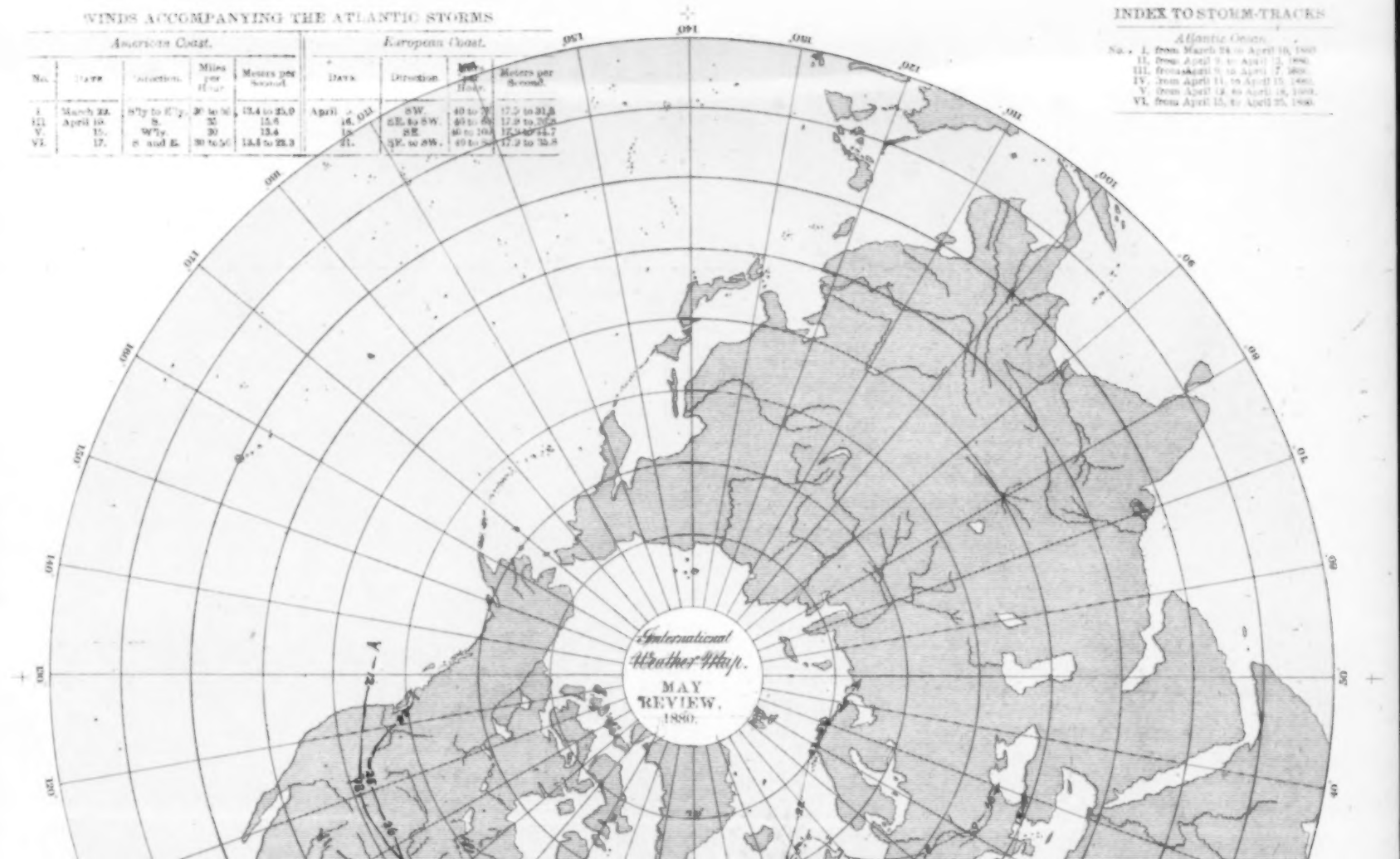
WINDS ACCOMPANYING THE ATLANTIC STORMS

No.	American Coast. Date	Direction	Miles per Hour	Meters per Second	European Coast. Days	Direction	Miles per Hour	Meters per Second
I.	March 22.	S'ly to E'ly.	20 to 36	13.4 to 23.0	April 4.	SW.	40 to 70	17.9 to 31.3
II.	April 10.	S.	35	15.6	14.	SE. to SW.	40 to 70	17.9 to 31.3
V.	15.	W'ly.	30	13.4	18.	SE.	40 to 70	17.9 to 31.3
VI.	17.	S. and E.	30 to 50	13.4 to 22.3	21.	SE. to SW.	40 to 70	17.9 to 31.3

INDEX TO STORM-TRACKS

Atlantic Ocean.

No. I. from March 24 to April 10, 1880.
II. from April 9 to April 12, 1880.
III. from April 9 to April 7, 1880.
IV. from April 11 to April 15, 1880.
V. from April 13 to April 18, 1880.
VI. from April 15 to April 25, 1880.



INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Reviews*.

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Albert J. Myer

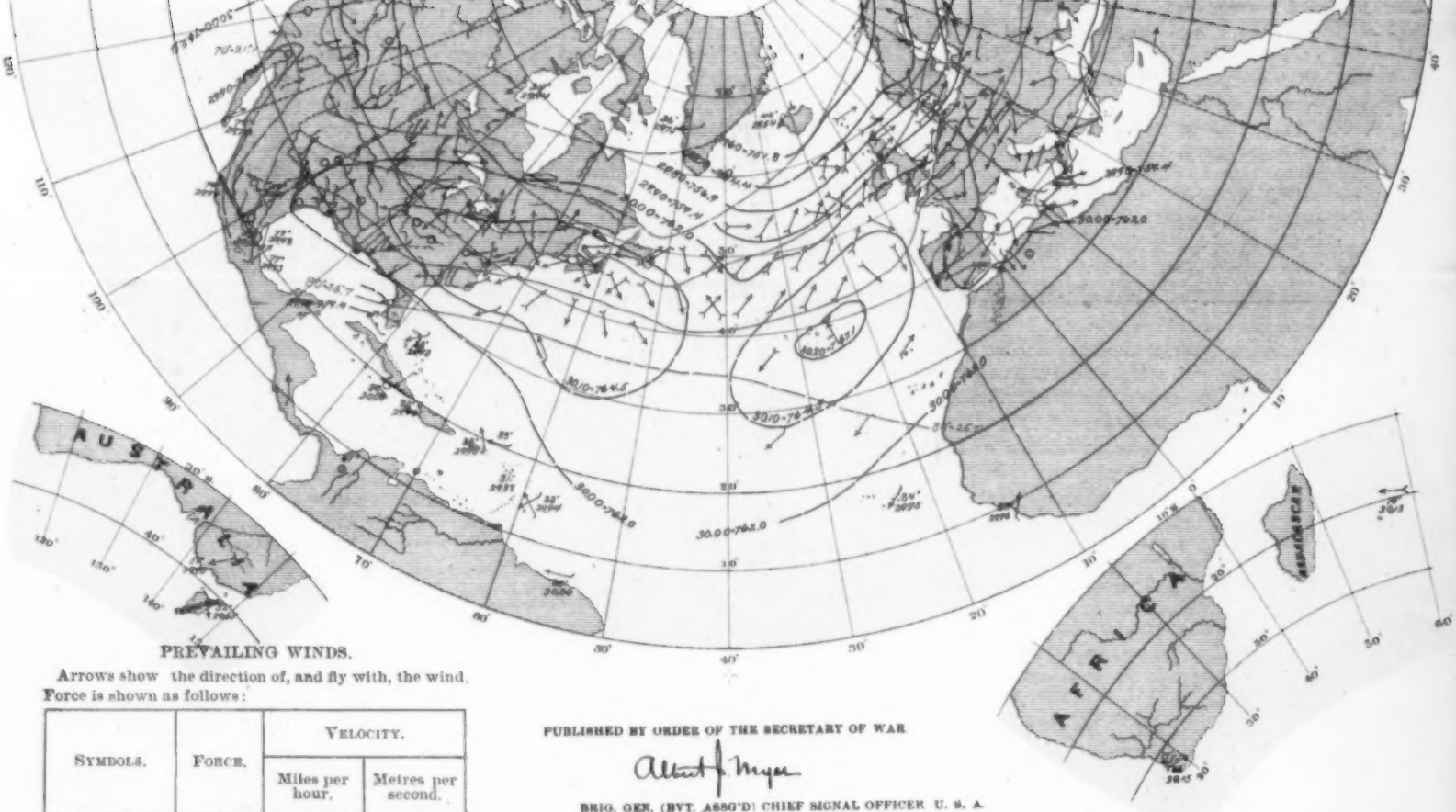
BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER U. S. A.

No. V.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing September, 1877.



PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up.	30.2 & over.

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Albert J. Myer

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

INTERNATIONAL MONTHLY CHART

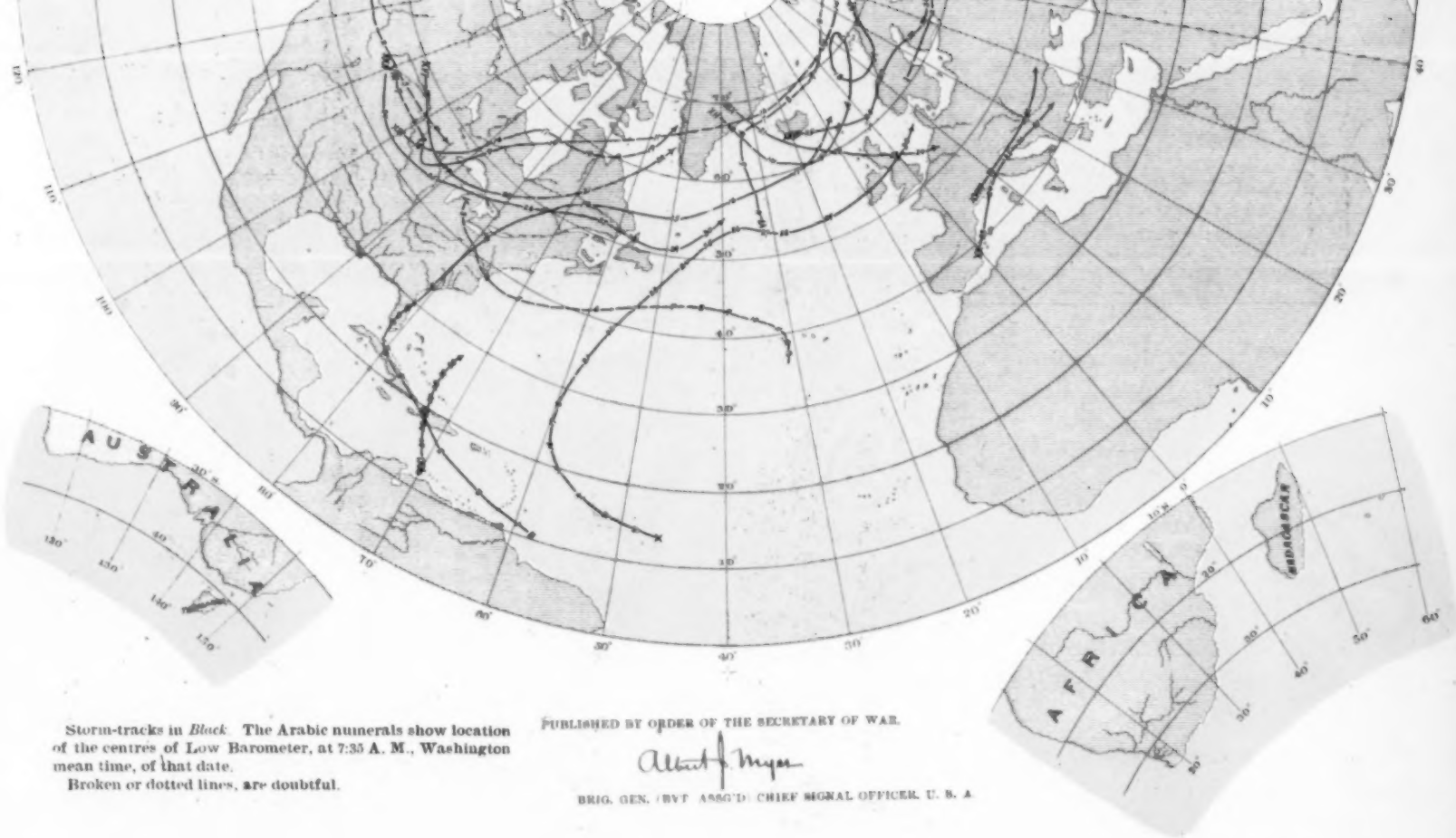
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of September, 1878, based on the daily charts of the International Bulletin

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing September, 1877.

No. VI.



Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER, U. S. A.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for September, 1878.